

**EXHIBIT 38**  
**[FILED UNDER SEAL]**

Page 1

IN THE UNITED STATES DISTRICT COURT  
FOR THE EASTERN DISTRICT OF TEXAS  
SHERMAN DIVISION

\*\*\*\*\*

THE STATE OF TEXAS, et al.,  
Plaintiffs

vs. CA NO. 4:20-cv-00957-sdj  
GOOGLE LLC,  
Defendant

\*\*\*\*\*

VIDEOTAPED DEPOSITION OF:

PARAG PATHAK, PH.D.

VERITEXT LEGAL SOLUTIONS

101 Arch Street

Boston, Massachusetts

October 14, 2024 9:04 a.m.

Darlene M. Coppola

Registered Merit Reporter

Certified Realtime Reporter

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| <p style="text-align: right;">Page 6</p> <p>1 PROCEEDING</p> <p>2</p> <p>3 (Commencing at 9:04 a.m.)</p> <p>4</p> <p>5 THE VIDEOGRAPHER: We are on the</p> <p>6 record. This is the videographer speaking,</p> <p>7 Shawn Budd, with Veritext Legal Solutions.</p> <p>8 Today's date is October 14, 2024, and the time</p> <p>9 is 9:04 a.m. We are here in Boston,</p> <p>10 Massachusetts, to take the video deposition of</p> <p>11 Professor Parag Pathak, in the matter of State</p> <p>12 of Texas versus Google LLC.</p> <p>13 Would counsel please introduce</p> <p>14 themselves for the record.</p> <p>15 MR. CHANG: Abraham Chang and</p> <p>16 Marisa Madaras on behalf of the State of</p> <p>17 Texas. With me in the room, I have Alex</p> <p>18 Abston, The Lanier Law Firm. With us on Zoom</p> <p>19 with the State of Texas, I have Trevor Young,</p> <p>20 Cole Pritchett, Jonathan Jaffe, Julian Cokic,</p> <p>21 and Brian Richter.</p> <p>22 MR. RYBNICEK: Jan Rybnicek and</p> <p>23 Xiaoxi Tu with Freshfields on behalf of</p> <p>24 Google.</p> | <p style="text-align: right;">Page 8</p> <p>1 I'm counsel for Google, along with my</p> <p>2 colleague, Xiaoxi Tu. You've been sworn in</p> <p>3 just now. You understand you're under oath</p> <p>4 and must testify completely and truthfully?</p> <p>5 A. Yes, I do.</p> <p>6 Q. Is there anything preventing you from</p> <p>7 testifying completely and truthfully today?</p> <p>8 A. There is not.</p> <p>9 Q. Great. I'd like to pass you two</p> <p>10 documents. The first is your June 7, 2024</p> <p>11 expert report.</p> <p>12 MR. RYBNICEK: We'll mark that</p> <p>13 Exhibit 1.</p> <p>14</p> <p>15 (Exhibit No. 1 marked for</p> <p>16 identification.)</p> <p>17</p> <p>18 MR. RYBNICEK: And the second</p> <p>19 document, we'll mark Exhibit 2, and it is</p> <p>20 dated September 9, 2024, and it is your</p> <p>21 rebuttal report in this matter.</p> <p>22</p> <p>23 (Exhibit No. 2 marked for</p> <p>24 identification.)</p>                                                                              |
| <p style="text-align: right;">Page 7</p> <p>1 THE VIDEOGRAPHER: Okay. Will</p> <p>2 the court reporter please swear in the</p> <p>3 witness.</p> <p>4</p> <p>5 PARAG PATHAK, PH.D.,</p> <p>6 a witness called for examination by</p> <p>7 counsel for the Plaintiff, having been</p> <p>8 satisfactorily identified by the production of</p> <p>9 his driver's license and being first duly</p> <p>10 sworn by the Notary Public, was examined and</p> <p>11 testified as follows:</p> <p>12</p> <p>13 THE STENOGRAPHER: Thank you.</p> <p>14 You may proceed.</p> <p>15</p> <p>16 DIRECT EXAMINATION</p> <p>17 BY MR. RYBNICEK:</p> <p>18 Q. Good morning, Professor Pathak. Can</p> <p>19 you please state and spell your name for the</p> <p>20 record.</p> <p>21 A. Sure. My name is Parag Pathak. The</p> <p>22 first name is spelled P-a-r-a-g. Last name is</p> <p>23 spelled P-a-t-h-a-k.</p> <p>24 Q. Thank you. My name is Jan Rybnicek.</p>                                                                                                                     | <p style="text-align: right;">Page 9</p> <p>1 BY MR. RYBNICEK:</p> <p>2 Q. Do you recognize these documents?</p> <p>3 A. I do.</p> <p>4 Q. And they're your reports?</p> <p>5 A. Yes.</p> <p>6 Q. Do you have any opinions in this case</p> <p>7 other than those that you've expressed in your</p> <p>8 two reports here?</p> <p>9 A. I do not.</p> <p>10 Q. And so your opening and rebuttal</p> <p>11 reports contain all of your opinions in this</p> <p>12 case; is that correct?</p> <p>13 A. Yes, that's correct.</p> <p>14 Q. Have you done any further analysis</p> <p>15 since submitting your reports?</p> <p>16 A. I have not, but I did find some typos</p> <p>17 in my reports. So I want to offer you those.</p> <p>18 I don't know if that counts as analysis, but I</p> <p>19 have a document with three typos.</p> <p>20 Q. Okay. Thank you.</p> <p>21 So aside from the typos that you've</p> <p>22 just provided me, is there anything you'd like</p> <p>23 to change in either of your reports?</p> <p>24</p> |

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| <p style="text-align: right;">Page 10</p> <p>1 A. No, there is not.</p> <p>2 Q. Is there anything you would like to</p> <p>3 add to either of your reports?</p> <p>4 A. No, there is not.</p> <p>5 Q. Is it fair to say that your reports --</p> <p>6 in your reports, you offer your opinion on</p> <p>7 whether Google's conduct is efficient?</p> <p>8 A. Yes, I do.</p> <p>9 Q. And you don't provide any opinions on</p> <p>10 whether Google's conduct was anticompetitive,</p> <p>11 correct.</p> <p>12 MR. CHANG: Objection. Form.</p> <p>13 A. My assignment was to look at Google's</p> <p>14 incentives to -- within the context of the</p> <p>15 markets at hand from the lens of market</p> <p>16 design, and the field of market design begins</p> <p>17 by diagnosing market failures. And one</p> <p>18 symptom of market failure involves the</p> <p>19 obstruction of efficiency. So in my review of</p> <p>20 the record, my analysis of market design</p> <p>21 issues overlaps with issues related to</p> <p>22 competition.</p> <p>23 BY MR. RYBNICEK:</p> <p>24 Q. Did you reach any independent</p>                                                                           | <p style="text-align: right;">Page 12</p> <p>1 Q. Can a market be inefficient but still</p> <p>2 competitive?</p> <p>3 A. So that's a very high-level question,</p> <p>4 so let me answer it with that in mind.</p> <p>5 When I teach my Ph.D. course in</p> <p>6 microeconomics, we introduce a definition of</p> <p>7 competitive markets, which involves the</p> <p>8 agents, the demand side, maximizing some</p> <p>9 objective, maximizing the utility; supply</p> <p>10 side, seeking some objective, like maximizing</p> <p>11 their profits and prices, which clear markets</p> <p>12 set demand equal to supply. And one of the</p> <p>13 first results that we establish -- I did this</p> <p>14 two weeks ago actually -- is what's called a</p> <p>15 first welfare theorem of microeconomics, which</p> <p>16 states that a competitive market is pareto</p> <p>17 efficient. So many people think of that</p> <p>18 formal result as the crowning achievement of</p> <p>19 microeconomic theory, at least up to the</p> <p>20 1950s.</p> <p>21 So with those definitions, I would say</p> <p>22 a competitive price equilibrium is efficient,</p> <p>23 or efficient as defined as what we would</p> <p>24 typically do, pareto efficiency in economics.</p>                                                                       |
| <p style="text-align: right;">Page 11</p> <p>1 conclusions about whether Google's conduct was</p> <p>2 anticompetitive?</p> <p>3 MR. CHANG: Objection. Form.</p> <p>4 A. There are parts of my report, as my</p> <p>5 assignment was to look at market design as</p> <p>6 aspects of Google's conduct here, that touch</p> <p>7 upon those issues.</p> <p>8 BY MR. RYBNICEK:</p> <p>9 Q. In your report, you indicate that you</p> <p>10 rely on Professor Gans' report for his</p> <p>11 determination on whether conduct was</p> <p>12 anticompetitive; is that correct?</p> <p>13 A. That is correct. And I also, in the</p> <p>14 course of reviewing the market design aspects</p> <p>15 of the matter here, I've looked at the effects</p> <p>16 of Google's conduct on competition.</p> <p>17 The way I teach my undergraduate class</p> <p>18 in market design is I start by saying why</p> <p>19 would you need to design a market? And, you</p> <p>20 know, the first couple of slides talk about</p> <p>21 the existence and presence of market power and</p> <p>22 absence of efficiency as primary reasons to</p> <p>23 think about designing markets. So there's</p> <p>24 overlap.</p> | <p style="text-align: right;">Page 13</p> <p>1 Q. I appreciate that. I think I asked a</p> <p>2 slightly different question, which is to say,</p> <p>3 can you have an inefficient market that is</p> <p>4 still competitive?</p> <p>5 A. So the second welfare theorem states</p> <p>6 that if we have an efficient allocation, then</p> <p>7 it comes about as a result of competition. So</p> <p>8 it's a converse of the result that I just</p> <p>9 stated for you. So, you know, defining</p> <p>10 competition as I've defined it, what we would</p> <p>11 say in economics is a price equilibrium where</p> <p>12 we have, you know, agents who are price takers</p> <p>13 who are maximizing their objectives, I would</p> <p>14 say that competitive markets are efficient.</p> <p>15 Now, this is such a high-level</p> <p>16 question, so there are settings where we have</p> <p>17 to think about environments where we don't</p> <p>18 have perfect competition as I would define it.</p> <p>19 So one thing that I focus on a lot in</p> <p>20 my own research as a market design scholar are</p> <p>21 markets where we don't have prices, and so an</p> <p>22 example of that would be a market where we're</p> <p>23 assigning objects to individuals. And you can</p> <p>24 have an outcome that is efficient that is not</p> |

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| <p style="text-align: right;">Page 14</p> <p>1 a consequence of competition as defined using</p> <p>2 while raising equilibrium like in the David</p> <p>3 Kreps or Mas-Colell, Whinston, and Green</p> <p>4 textbooks that I cite in my report.</p> <p>5 So there's other mechanisms that lead</p> <p>6 to efficient outcomes beyond competitive</p> <p>7 mechanisms. I'll give you a specific example</p> <p>8 maybe to clarify.</p> <p>9 So let's say we are trying to assign</p> <p>10 dormitories to MIT students. Okay. MIT</p> <p>11 students do not pay a price for dorms, right,</p> <p>12 so it's a market where there's no price. So</p> <p>13 we don't have the opportunity to define price</p> <p>14 equilibrium or competitive equilibrium.</p> <p>15 But an allocation that works as</p> <p>16 follows, let's just ask whoever is first in</p> <p>17 line, What's your preferred dorm? You get to</p> <p>18 pick. Maybe we do it based on seniority. And</p> <p>19 then we go to the next person in line and ask</p> <p>20 them, "Which dorm do you like the most?" so on</p> <p>21 and so forth.</p> <p>22 That's a particular priority</p> <p>23 mechanism. That's not a competitive</p> <p>24 mechanism, but in that specific context, that</p> | <p style="text-align: right;">Page 16</p> <p>1 equal to supply. So those are the two</p> <p>2 essential ingredients of competitive</p> <p>3 equilibrium or price equilibrium. I'm using</p> <p>4 those terms synonymously.</p> <p>5 Q. I believe you also referenced perfect</p> <p>6 competition earlier.</p> <p>7 A. (Witness nodding.)</p> <p>8 Q. Can you explain that?</p> <p>9 A. Perfect competition is the way</p> <p>10 economists describe agents being price takers.</p> <p>11 So their ability to influence the price is</p> <p>12 negligible. So the technical definition of</p> <p>13 perfect competition usually involves some kind</p> <p>14 of limit in an informal model. For instance,</p> <p>15 if we have a large number of consumers,</p> <p>16 sometimes people even model this as a</p> <p>17 continuum of consumers.</p> <p>18 So let's say we have a line from zero</p> <p>19 to one and we have a consumer at each value</p> <p>20 numerical between zero and one. So in</p> <p>21 principle, that's an infinite number of</p> <p>22 consumers because there's an infinite number</p> <p>23 of numbers between zero and one. And perfect</p> <p>24 competition in that setting means consumers</p>                                          |
| <p style="text-align: right;">Page 15</p> <p>1 mechanism generates an outcome that is</p> <p>2 efficient.</p> <p>3 Q. Okay. That's all very helpful.</p> <p>4 You've touched or said a couple of</p> <p>5 times or referenced a couple of times the idea</p> <p>6 of price equilibrium. What do you mean by</p> <p>7 that?</p> <p>8 A. Price equilibrium, as defined in</p> <p>9 economics as I teach my undergraduates and my</p> <p>10 Ph.D. students, has two essential ingredients.</p> <p>11 The first is that there are agents who are</p> <p>12 maximizing their objectives. We would call</p> <p>13 that the -- for consumers, their utility</p> <p>14 maximization problem. What's essential is</p> <p>15 that agents are price takers, so their</p> <p>16 decisions to choose a consumption bundle, if</p> <p>17 it's an exchange economy setting, let's say,</p> <p>18 are taking prices as given. So given what the</p> <p>19 price schedule is, they make a decision that</p> <p>20 achieves their goal, which is to maximize</p> <p>21 utility. So that's the first ingredient.</p> <p>22 The second ingredient is the prices</p> <p>23 are such that the market's clear. So the</p> <p>24 price is going to be set such that demand is</p>         | <p style="text-align: right;">Page 17</p> <p>1 taking the price, when they take their action,</p> <p>2 they don't need to consider the behavior of</p> <p>3 other agents to figure out what's their best</p> <p>4 action. It's only sufficient to think about</p> <p>5 what the price is.</p> <p>6 Q. Is it fair to say perfect competition</p> <p>7 is when price equals marginal cost?</p> <p>8 A. Yes, that would be a definition of</p> <p>9 perfect competition on the firm side. So the</p> <p>10 way that that reflects what I just talked</p> <p>11 about is, when a firm is seeking to maximize</p> <p>12 their objectives, we would say they solve the</p> <p>13 profit maximization problem. So that is</p> <p>14 maximizing their total revenue minus costs.</p> <p>15 And in a model of perfect competition, they</p> <p>16 take the price as given from the market. So</p> <p>17 if we observe the firm's profit maximization</p> <p>18 problem, they would choose a quantity such</p> <p>19 that we differentiate that profit maximization</p> <p>20 problem. And the conclusion of that would be</p> <p>21 price is equal to marginal cost.</p> <p>22 Q. And how often does that happen in the</p> <p>23 market?</p> <p>24 A. Perfect competition?</p> |

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| <p style="text-align: right;">Page 18</p> <p>1 Q. Correct.</p> <p>2 A. I haven't done a study across</p> <p>3 industries of that. The way I like to think</p> <p>4 about these types of models is they're</p> <p>5 benchmark situations. So if you think about</p> <p>6 does a firm have the ability to exercise power</p> <p>7 over price -- there's a debate, in fact, in</p> <p>8 academic economics right now about your very</p> <p>9 question, and I don't think it's, you know,</p> <p>10 very easy to answer your question with any</p> <p>11 degree of precision.</p> <p>12 So, you know, that debate broadly</p> <p>13 speaks to certain industries and looks at</p> <p>14 specific actions of agents in particular</p> <p>15 industries to describe whether the model of</p> <p>16 perfect competition is a good approximation or</p> <p>17 if other models are good approximations.</p> <p>18 Another way people have looked at</p> <p>19 this, which I'm not a big fan of, is trying to</p> <p>20 calculate a markup.</p> <p>21 So markup is defined as price minus</p> <p>22 marginal cost divided by price and using that</p> <p>23 as an index of how competitive the industries</p> <p>24 are. So we know from economics -- what I</p>                      | <p style="text-align: right;">Page 20</p> <p>1 firm is not pricing at marginal cost, it has</p> <p>2 some market power?</p> <p>3 A. It's -- again, this is such a</p> <p>4 high-level question that we'd have to get into</p> <p>5 some specific context. So in a -- the</p> <p>6 stylized Econ 101 representation of firm</p> <p>7 behavior, we would be ignoring things like</p> <p>8 fixed costs; we would be ignoring things like</p> <p>9 adjustment costs in general. The stylized</p> <p>10 model where folks might make such a claim</p> <p>11 ignores dynamics.</p> <p>12 So it's hard for me to give a precise</p> <p>13 answer without more specific context. It</p> <p>14 would depend on institutional features of the</p> <p>15 setting.</p> <p>16 Q. And in what situations would a firm</p> <p>17 not have market power if they're pricing above</p> <p>18 marginal cost?</p> <p>19 A. If we think about a firm that has</p> <p>20 fixed costs and is in a competitive industry</p> <p>21 and is needing to price in a way to cover</p> <p>22 their fixed costs, so that would be one type</p> <p>23 of example. So there's, you know, a continuum</p> <p>24 of firms.</p> |
| <p style="text-align: right;">Page 19</p> <p>1 teach my undergraduates is inverse elasticity</p> <p>2 rule or the Lerner rule.</p> <p>3 And the Lerner rule is solving the</p> <p>4 profit maximization problem that we just</p> <p>5 talked about in the case where a firm's choice</p> <p>6 of quantity does take into consideration what</p> <p>7 the price would be. So that's an example of a</p> <p>8 firm that's not a price taker but is aware of</p> <p>9 how their quantity choice influences what the</p> <p>10 level of demand will be.</p> <p>11 And if you work through the profit</p> <p>12 maximization problem, you can construct a</p> <p>13 Lerner index. So that's the price minus</p> <p>14 marginal cost divided by price. And</p> <p>15 economists -- and this is currently again an</p> <p>16 active debate -- attempt to try to measure</p> <p>17 what the Lerner index is across industries.</p> <p>18 And that's a challenging exercise because it</p> <p>19 requires you have a precise measure of costs,</p> <p>20 and it requires you to think that this profit</p> <p>21 maximization problem is sufficient to capture</p> <p>22 the incentives of the firms.</p> <p>23 BY MR. RYBNICEK:</p> <p>24 Q. And is it accurate to say that if a</p> | <p style="text-align: right;">Page 21</p> <p>1 We think of models in economics like</p> <p>2 this where to enter, you pay some fixed cost.</p> <p>3 And once you enter, you're in a marketplace</p> <p>4 where there are many other competitors and</p> <p>5 your price doesn't simply reflect your</p> <p>6 marginal -- your static marginal cost. So</p> <p>7 situations where there's dynamics would</p> <p>8 generate examples like that.</p> <p>9 Q. Are markets in which a firm is pricing</p> <p>10 above marginal cost anticompetitive?</p> <p>11 MR. CHANG: Objection. Form.</p> <p>12 A. I think we have to be much more</p> <p>13 specific about --</p> <p>14 BY MR. RYBNICEK:</p> <p>15 Q. Sure --</p> <p>16 A. -- what the markets are in hand. So I</p> <p>17 can't answer that without more specifics.</p> <p>18 Q. Is having market power -- strike that.</p> <p>19 If a firm has market power, does that</p> <p>20 necessarily mean a market is</p> <p>21 anticompetitive?</p> <p>22 MR. CHANG: Objection. Form.</p> <p>23 BY MR. RYBNICEK:</p> <p>24 Q. Actually, I'll take that back, and</p>                                                                           |



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| <p style="text-align: right;">Page 22</p> <p>1 I'll say, if a firm has market power, does</p> <p>2 that necessarily mean a market is not</p> <p>3 competitive?</p> <p>4 A. This is such a high-level question.</p> <p>5 To be more specific, is there a -- I think I</p> <p>6 need more context to answer that question.</p> <p>7 Q. What context would you need?</p> <p>8 A. So market power involves -- one</p> <p>9 definition of market power is power over</p> <p>10 price. Another definition is the power to</p> <p>11 exclude competitors. So actually, could you</p> <p>12 restate the question?</p> <p>13 Q. Sure.</p> <p>14 A. Make sure I'm answering it.</p> <p>15 Q. If a firm has market power, meaning</p> <p>16 power over price --</p> <p>17 A. Okay.</p> <p>18 Q. -- does that necessarily mean a market</p> <p>19 is not competitive?</p> <p>20 A. One example that doesn't fit that</p> <p>21 model is a firm that has increasing returns to</p> <p>22 scale technologies. So you could imagine a</p> <p>23 firm that has power over price, but the</p> <p>24 technology, the production function of the</p>                                                                                                            | <p style="text-align: right;">Page 24</p> <p>1 economics has demand equaling supply. And if</p> <p>2 you look at the area under the demand curve up</p> <p>3 to the supply curve, that's a measure of</p> <p>4 consumer and producer surplus.</p> <p>5 When you have a monopolist or a firm</p> <p>6 with power over price in that model, then we</p> <p>7 have a restriction of quantity because the</p> <p>8 monopolist is wary of how their price-setting</p> <p>9 behavior affects demands because they're not</p> <p>10 taking prices as given. And we have a point</p> <p>11 where prices are higher than the competitive</p> <p>12 level and quantity is lower, so that generates</p> <p>13 deadweight loss, so reduction in both consumer</p> <p>14 surplus and consumer surplus, and that would</p> <p>15 be a textbook definition of market failure.</p> <p>16 Q. Okay. So I think this might get us</p> <p>17 back to where I started, which is, if market</p> <p>18 power is a market failure, that is a market</p> <p>19 inefficiency, correct?</p> <p>20 A. As a general proposition in the</p> <p>21 stylized models of economics, I would agree</p> <p>22 with that, yes.</p> <p>23 Q. Okay. And it's also possible that you</p> <p>24 could have a market in which you have market</p> |
| <p style="text-align: right;">Page 23</p> <p>1 firm satisfies the -- a mathematical property</p> <p>2 that we call increasing returns to scale. And</p> <p>3 so that firm could have power over price and</p> <p>4 satisfy the conditions that you just raised.</p> <p>5 Q. So simply having power over price is</p> <p>6 not determinative of whether a market is</p> <p>7 competitive, correct?</p> <p>8 MR. CHANG: Objection. Form.</p> <p>9 A. I mean, it's a symptom of whether a</p> <p>10 market is competitive or not. But as an</p> <p>11 absolute rule, to study whether the outcome is</p> <p>12 competitive or not, one would need a lot more</p> <p>13 detail, the circumstances of the market, what</p> <p>14 the production technologies are, other</p> <p>15 institutional factors.</p> <p>16 BY MR. RYBNICEK:</p> <p>17 Q. But market power is a market failure;</p> <p>18 is that correct?</p> <p>19 A. In the standard, simple, plain vanilla</p> <p>20 model, what we would say is, if a firm in that</p> <p>21 model has power over price, the way we teach</p> <p>22 our undergraduates is that generates what's</p> <p>23 called a deadweight loss. So the usual</p> <p>24 diagram that we teach in undergraduate</p> | <p style="text-align: right;">Page 25</p> <p>1 power, which in your market design field is a</p> <p>2 market inefficiency, but it is still</p> <p>3 competitive, correct?</p> <p>4 A. There are cases where that can occur,</p> <p>5 yes.</p> <p>6 Q. Great. Thank you.</p> <p>7 So I think I may have already asked</p> <p>8 this, but just to be sure, you rely on</p> <p>9 Professor Gans' opinion for whether Google's</p> <p>10 conduct was anticompetitive, right?</p> <p>11 A. I rely on his opinion, but I also</p> <p>12 looked at the conduct myself. And as we</p> <p>13 discussed, one of the first things a design</p> <p>14 economist looks at is is there a need for</p> <p>15 design here, and so we look for symptoms of</p> <p>16 problems. And in my review of those symptoms,</p> <p>17 I saw examples of Google's conduct that got in</p> <p>18 the way of the principles of market design,</p> <p>19 like efficiency, and so that overlaps with</p> <p>20 some of Gans' analysis.</p> <p>21 Q. And did you rely on anyone other than</p> <p>22 Professor Gans for conclusions about Google's</p> <p>23 conduct being anticompetitive?</p> <p>24 A. No.</p>                                                                                                                        |



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| <p style="text-align: right;">Page 26</p> <p>1 Q. Okay. And how do you determine if</p> <p>2 conduct is anticompetitive?</p> <p>3 A. So as a market design economist, your</p> <p>4 starting point is looking at what are the</p> <p>5 valuable principles in a design market. So,</p> <p>6 you know, a very lucid explanation of those</p> <p>7 principles is in Al Roth's textbook "Who Gets</p> <p>8 What and Why," where he talks about, you know,</p> <p>9 the need to maximize surplus or the gains from</p> <p>10 trade. He talks about congestion or the</p> <p>11 timing of transactions as getting in the way</p> <p>12 of good outcomes. He talks about transparency</p> <p>13 or safety, as he calls it.</p> <p>14 And so with that lens, I'm looking at</p> <p>15 Google's conduct here. And so the kind of</p> <p>16 precise legal dimensions of anticompetitive</p> <p>17 conduct is not what I was assigned to look at,</p> <p>18 but when I see, you know, Google signing an</p> <p>19 agreement, say, with Facebook on header</p> <p>20 bidding and exchange bidding, the Facebook</p> <p>21 audience network deal that I talk about in my</p> <p>22 opening report, which ultimately results in</p> <p>23 Facebook exiting the display market, I see</p> <p>24 that as a lost opportunity for gains from</p> | <p style="text-align: right;">Page 28</p> <p>1 earlier about perfect competition, right? So</p> <p>2 that's envisaged as a model where we have</p> <p>3 many, many firms competing against each other,</p> <p>4 and that's where we can harness the forces of</p> <p>5 competition to generate efficient outcomes.</p> <p>6 And so as we move away from that, it's a</p> <p>7 direction that's moving towards less</p> <p>8 competition.</p> <p>9 Again, this is as a general model --</p> <p>10 principle.</p> <p>11 Q. You mentioned earlier that what you</p> <p>12 observed in the record is fewer gains from</p> <p>13 trade than you would expect in an absence on</p> <p>14 Google's conduct.</p> <p>15 What do -- what does gains from trade</p> <p>16 have to do with competition?</p> <p>17 A. Well, when we talk about the effects</p> <p>18 of competition, back to our discussion of the</p> <p>19 first welfare theorem, we say that competition</p> <p>20 generates an efficient outcome, and in an</p> <p>21 efficient outcome, we are maximizing the gains</p> <p>22 from trade. So competition supports the</p> <p>23 maximization of the gains from trade.</p> <p>24 Q. I think this does take us back to</p>             |
| <p style="text-align: right;">Page 27</p> <p>1 trade because header bidding, had it been more</p> <p>2 successful, could have allowed more matches to</p> <p>3 form in the market. And the particular</p> <p>4 Facebook audience network deal eventually led</p> <p>5 to the exit of a competitor, and so that is,</p> <p>6 you know, bad for market design principles.</p> <p>7 Q. So you said that is bad for market</p> <p>8 design principles.</p> <p>9 A. (Witness nodding.)</p> <p>10 Q. How do you know it's bad from a</p> <p>11 competition perspective?</p> <p>12 A. Well, one measure of competition is</p> <p>13 the number of firms that are competing. So</p> <p>14 when Facebook is no longer competing, there's</p> <p>15 one fewer firm competing, so that would be bad</p> <p>16 for competition.</p> <p>17 Q. So it's your opinion that competition</p> <p>18 is harmed if one firm is taken out of the</p> <p>19 market?</p> <p>20 A. In this -- I'm talking about the</p> <p>21 specific example.</p> <p>22 So within the context of this specific</p> <p>23 example, you know, generally, as an economist,</p> <p>24 we think of these two extremes. You asked me</p>                                                                                                                                     | <p style="text-align: right;">Page 29</p> <p>1 another line of questions we had, which is</p> <p>2 there -- or is it your opinion that in</p> <p>3 competitive markets there cannot be additional</p> <p>4 gains from trade?</p> <p>5 MR. CHANG: Objection. Form.</p> <p>6 A. This is a little bit circular, so I --</p> <p>7 to answer this question, I need to have a</p> <p>8 specific competitive model in mind. So why</p> <p>9 don't I start with a model that we teach our</p> <p>10 undergraduates and Ph.D. students, what I</p> <p>11 teach at MIT every year.</p> <p>12 If I define the competitive model as</p> <p>13 it's done in the textbooks, you know, Kreps,</p> <p>14 Mas-Colell, Whinston, and Green, or even Hal</p> <p>15 Varian's textbook, which is, you know, the</p> <p>16 chief economist at Google, a competitive</p> <p>17 outcome is maximizing the gains from trade.</p> <p>18 BY MR. RYBNICEK:</p> <p>19 Q. I think I had a slightly different</p> <p>20 question which is is it your opinion that in a</p> <p>21 market that is competitive, it is not possible</p> <p>22 to increase the efficiency and achieve</p> <p>23 additional gains from trade?</p> <p>24 A. It depends on the circumstances at</p> |

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| <p style="text-align: right;">Page 30</p> <p>1 hand. So again, back to static versus dynamic<br/>2 models, are we talking about what's in the<br/>3 textbook, or are we talking about particular<br/>4 markets at hand? So let me give you an<br/>5 example.<br/>6 Let's say we have a dynamic model, two<br/>7 periods. Okay. So Period 1, full<br/>8 competition. Period 2, we can make an<br/>9 investment. Some firms can make an investment<br/>10 to decrease their costs. In Period 2, we can<br/>11 have additional gains from trade. So when you<br/>12 talk about maximizing the gains from trade, is<br/>13 it with respect to Period 1, or is it respect<br/>14 to the aggregate gains from trade across both<br/>15 periods?<br/>16 The answer to these questions in the<br/>17 abstract, right, this is why I'm going back to<br/>18 the textbooks. They're very high-level<br/>19 questions. To give you a more precise answer,<br/>20 we'd have to talk about very specific<br/>21 setting.<br/>22 Q. Can you give me an example of a<br/>23 competitive market?<br/>24 A. You know, one example people sometimes</p>                  | <p style="text-align: right;">Page 32</p> <p>1 So let's imagine in this specific<br/>2 context my housekeeper has access to a<br/>3 technology, to, like, a new vacuum cleaner<br/>4 that can reduce the amount of time it takes to<br/>5 complete her job. So that technology would<br/>6 allow her and other folks who have access to<br/>7 that technology to maybe get the job done more<br/>8 quickly. So that's an example.<br/>9 Q. Okay. That's helpful. This is what I<br/>10 was trying to clear up is whether or not a<br/>11 competitive market could become more efficient<br/>12 or if it -- if maximum efficiency is identical<br/>13 to perfect competition.<br/>14 A. Is there a question there?<br/>15 Q. Would -- in your housekeeper example,<br/>16 if one housekeeper gained a new piece of<br/>17 technology to allow them to do their work more<br/>18 productively, is that competitive -- quote,<br/>19 competitive?<br/>20 MR. CHANG: Objection. Form.<br/>21 A. If one housekeeper had the option to<br/>22 get that technology and there's no ability any<br/>23 other housekeeper in that market could also<br/>24 access that technology, is that the context of</p> |
| <p style="text-align: right;">Page 31</p> <p>1 talk about is the market for housekeeping<br/>2 services. There are many participants.<br/>3 There's many people who are, you know, able<br/>4 to, say, clean your house. Any given<br/>5 housecleaner's ability to set price is<br/>6 affected in large part by market-level<br/>7 conditions. So the person who helps our<br/>8 family cannot charge way too high a price<br/>9 because I have the opportunity to hire someone<br/>10 else. And there's a price, so there's, you<br/>11 know, not nonprice issue that we talked about<br/>12 a second ago.<br/>13 So what I would say -- again, these<br/>14 are models, right -- so I would say the<br/>15 lessons from the competitive model, I think,<br/>16 are the right place to start to think about<br/>17 housekeeping services at least, say, in<br/>18 Greater Boston.<br/>19 Q. And because the housekeeping market is<br/>20 competitive, does that mean that it cannot<br/>21 become more efficient?<br/>22 A. No. Again, list -- I think I've kind<br/>23 of given you the example of a static versus<br/>24 dynamic view of this.</p> | <p style="text-align: right;">Page 33</p> <p>1 your question?<br/>2 BY MR. RYBNICEK:<br/>3 Q. Not necessarily that every housekeeper<br/>4 could get it. There are resource constraints,<br/>5 right? So my example is one housekeeper is<br/>6 able to obtain, either through ingenuity or<br/>7 resources, additional technology.<br/>8 A. Yes.<br/>9 Q. Does that make the market less<br/>10 competitive?<br/>11 MR. CHANG: Objection to form.<br/>12 A. I wouldn't say that the market is less<br/>13 competitive because, you know, one of the kind<br/>14 of grounding principles of competitive theory<br/>15 in economics is that agents have choices that<br/>16 they get to make independently.<br/>17 I mean, if you think about one of the<br/>18 godfathers of competitive theory, Milton<br/>19 Friedman, right, the title of his book is<br/>20 "Free to Choose," right? So if a housekeeper<br/>21 is free to choose a technology, whatever<br/>22 vacuum cleaner system she or he wishes, then<br/>23 that's their prerogative.<br/>24 And that is the beauty of competitive</p>                                                                                                  |

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| <p style="text-align: right;">Page 34</p> <p>1 markets, that a housekeeper making</p> <p>2 uncoordinated choices, unconstrained choices</p> <p>3 can lead to efficient outcomes. That, you</p> <p>4 know, is the essence of Adam Smith's</p> <p>5 hypothesis in economics.</p> <p>6 BY MR. RYBNICEK:</p> <p>7 Q. And if other competing housekeepers</p> <p>8 are also able to obtain that technology, it</p> <p>9 would be your opinion that the market would be</p> <p>10 more efficient; is that fair?</p> <p>11 MR. CHANG: Objection. Form.</p> <p>12 A. What -- if we're in a competitive</p> <p>13 environment where agents are able to act in</p> <p>14 their own best interests, then we're back to</p> <p>15 the competitive model. So they can make that</p> <p>16 choice -- free unconstrained choice. That's</p> <p>17 the essence of the competitive model.</p> <p>18 BY MR. RYBNICEK:</p> <p>19 Q. I think earlier you -- I asked you how</p> <p>20 you identify if conduct is anticompetitive,</p> <p>21 and I believe you pointed to the -- your</p> <p>22 principles of market design; is that right?</p> <p>23 A. That was my assignment, to bring a</p> <p>24 market design lens to look at Google's</p>                            | <p style="text-align: right;">Page 36</p> <p>1 correct?</p> <p>2 A. No. The outcome is inefficient, I</p> <p>3 said, because we have separate venues. I'm</p> <p>4 going to make sure I -- I'm not sure about --</p> <p>5 maybe you could restate the question. I want</p> <p>6 to make sure I'm answering your question.</p> <p>7 Q. I'm trying to understand how thickness</p> <p>8 relates to competition. Does a lack of</p> <p>9 thickness mean there is no competition?</p> <p>10 A. A lack of thickness gets in the way of</p> <p>11 competitive outcomes is how I would state it.</p> <p>12 So imagine we had a -- let's go back to the</p> <p>13 housekeeping market, right? So that in Boston</p> <p>14 is a market where there is many people who</p> <p>15 need housecleaning services and there are many</p> <p>16 providers, and they can interact with each</p> <p>17 other and find beneficial matches.</p> <p>18 Now, imagine that that market were</p> <p>19 segmented in a way that certain housekeepers,</p> <p>20 for whatever reason, are not able to access</p> <p>21 certain homes.</p> <p>22 So take a particular geographic area</p> <p>23 of Boston and suppose certain housekeepers are</p> <p>24 prohibited from being able to clean houses in</p>                                |
| <p style="text-align: right;">Page 35</p> <p>1 conducts and the incentives underlying</p> <p>2 Google's conducts. And in the course of doing</p> <p>3 that assignment, I observed certain conduct</p> <p>4 that, you know, was bad for the market, had</p> <p>5 bad -- you know, bad for competition.</p> <p>6 Q. And that is because the conduct made</p> <p>7 markets less thick and less safe and more</p> <p>8 congested; is that your opinion?</p> <p>9 A. That's the market design framework</p> <p>10 that I bring to my assignment here, yes.</p> <p>11 Q. And how does thickness relate to</p> <p>12 competition?</p> <p>13 A. So the market design principle of</p> <p>14 thickness is trying to ensure that we have</p> <p>15 enough participants, buyers and sellers</p> <p>16 together, in a market to maximize the gains</p> <p>17 from trade. So if we don't, for instance, if</p> <p>18 a market is segmented such that only certain</p> <p>19 participants can transact in certain venues,</p> <p>20 then we will not have maximized the gains from</p> <p>21 trade, and that is an outcome that's</p> <p>22 inefficient.</p> <p>23 Q. The outcome is inefficient, but it may</p> <p>24 still occur in a competitive marketplace,</p> | <p style="text-align: right;">Page 37</p> <p>1 Newton, Massachusetts, where I live, right?</p> <p>2 They can only clean houses in downtown Boston,</p> <p>3 where we are right now. Then we have gotten</p> <p>4 in the way -- even though they're able to</p> <p>5 clean houses in downtown Boston, we've gotten</p> <p>6 in the way of those housekeepers in downtown</p> <p>7 Boston from finding potentially beneficial</p> <p>8 matches and therefore maximizing surplus by</p> <p>9 not letting them clean houses in the adjacent</p> <p>10 town.</p> <p>11 Q. Is that true even though, in your</p> <p>12 example, in downtown Boston, there are a</p> <p>13 separate set of competitors who are competing</p> <p>14 for housekeeping services?</p> <p>15 A. Yes, because there could be more</p> <p>16 beneficial matches. Like, in my -- the</p> <p>17 specific example, you know, there could be</p> <p>18 someone like our household who would like not</p> <p>19 only cleaning services but also someone to</p> <p>20 assist our family -- both myself and my wife</p> <p>21 work. We have two young kids -- with cleaning</p> <p>22 services as well as cooking services. Okay?</p> <p>23 And I am originally from Nepal, and there are</p> <p>24 many housekeepers in Greater Boston who are</p> |

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| <p style="text-align: right;">Page 38</p> <p>1 from Nepal, and it would be lovely to have<br/> 2 someone else who will cook Nepalese food at<br/> 3 our house.<br/> 4 So we are fortunate that there's<br/> 5 someone from downtown Boston who is able to<br/> 6 come to the suburbs and assist our household.<br/> 7 And had that person been prohibited from<br/> 8 coming to the suburbs, we have missed on the<br/> 9 opportunity of -- from gains from trade<br/> 10 because there's not that many Nepalese<br/> 11 housekeepers in who live in Newton,<br/> 12 Massachusetts.<br/> 13 Q. So the relevant market would be<br/> 14 Nepalese housekeepers who live in Newton?<br/> 15 A. I'm just giving you an example here of<br/> 16 why having segmentation of markets can get in<br/> 17 the way of efficiency. To answer your<br/> 18 question about thickness, right, so allowing<br/> 19 people to be able to transact in the most<br/> 20 unconstrained way so that we can find matches<br/> 21 is good for market outcomes.<br/> 22 Q. Again, I think we're talking past each<br/> 23 other a little bit because I'm not asking<br/> 24 about efficiency. I'm asking about</p> | <p style="text-align: right;">Page 40</p> <p>1 town, then that is a rule that gets in the way<br/> 2 of competition, and, as a result the outcome,<br/> 3 you know, of that arrangement is going to be<br/> 4 inefficient.<br/> 5 Q. That's interesting. From whose<br/> 6 perspective do you evaluate competition?<br/> 7 A. The usual way that we think about<br/> 8 competition is the -- how the agents in the<br/> 9 model interact. So in this specific<br/> 10 situation, we would be looking at the demand<br/> 11 side. So that would be people, let's say,<br/> 12 like me or others who need housekeeping<br/> 13 services, and the supply side, which are<br/> 14 people who are able to offer those services.<br/> 15 So those are the agents that we would be<br/> 16 thinking about in terms of defining what<br/> 17 competition means there.<br/> 18 Q. But in terms of evaluating if a market<br/> 19 is competitive, do you agree that the<br/> 20 principle stakeholder is the consumer that you<br/> 21 would look at?<br/> 22 A. Not necessarily.<br/> 23 Q. When you -- when you evaluate whether<br/> 24 a conduct is anticompetitive, you do not focus</p> |
| <p style="text-align: right;">Page 39</p> <p>1 competition.<br/> 2 A. Uh-huh.<br/> 3 Q. And I think we talked earlier about<br/> 4 how they're not exactly the same thing, right?<br/> 5 A. (Witness nodding.)<br/> 6 Q. You don't disagree with that now, do<br/> 7 you?<br/> 8 A. Competition is not the same thing as<br/> 9 efficiency. Competition is a way that actors<br/> 10 in a market interact. Efficiency is a<br/> 11 property of the allocation, yeah.<br/> 12 Q. Right. And so you can have a<br/> 13 competitive market that is maybe not as<br/> 14 efficient as you would like, correct?<br/> 15 A. Well, in my example of the<br/> 16 housekeeper, I wouldn't say a prohibition on<br/> 17 the housekeeper going across town lines is<br/> 18 unconstrained competition. Their choices have<br/> 19 been constrained. So if you were to ask them,<br/> 20 What is the decision that you would take that<br/> 21 maximizes your utility? the housekeeper would<br/> 22 say, I would really like to work with this<br/> 23 Nepalese family. And if we have a rule that<br/> 24 says you're not allowed to go into the other</p>                                            | <p style="text-align: right;">Page 41</p> <p>1 on the consumer?<br/> 2 MR. CHANG: Objection. Form.<br/> 3 A. In the abstract. I mean, what we<br/> 4 teach our undergraduates is we have monopoly<br/> 5 and we have monopsony, right, which is looking<br/> 6 at workers and price setting of workers,<br/> 7 right? So that's on the supply side.<br/> 8 And when you have the exercise of<br/> 9 market power, power over price, as an example,<br/> 10 on the supply side, then that would be another<br/> 11 way to say the outcomes are inefficient.<br/> 12 BY MR. RYBNICEK:<br/> 13 Q. Sure. Putting monopsony aside, okay,<br/> 14 looking at monopoly --<br/> 15 A. Okay.<br/> 16 Q. -- and competitive effects from<br/> 17 monopoly --<br/> 18 A. Uh-huh.<br/> 19 Q. -- do you disagree that the principle<br/> 20 source at which you look for the effect of the<br/> 21 conduct is the consumer?<br/> 22 A. Well, as a market design economist,<br/> 23 I'm looking at both producer and consumer<br/> 24 surplus. So even in the case of monopoly,</p>                                                                                                               |

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| <p style="text-align: right;">Page 42</p> <p>1 monopolists have deadweight loss, and that</p> <p>2 constrains both producer and consumer surplus.</p> <p>3 Q. And so a consumer could be better off,</p> <p>4 but a producer could be harmed, and that could</p> <p>5 be bad for competition, in your view?</p> <p>6 A. In principle, in the abstract, yes.</p> <p>7 Q. If a consumer's prices are going down,</p> <p>8 is that likely a sign a market is competitive?</p> <p>9 A. Not necessarily.</p> <p>10 Q. If output is increasing, is that an</p> <p>11 indication that market is competitive?</p> <p>12 A. Not necessarily. I mean, the great</p> <p>13 example of oil cartels, right, that's an</p> <p>14 example where there's coordinated price</p> <p>15 setting. So the cartel members have power</p> <p>16 over price.</p> <p>17 There are periods in history where the</p> <p>18 total amount of oil that's being produced has</p> <p>19 gone up over time. I mean, any proper</p> <p>20 analysis of those kinds of questions needs to</p> <p>21 do a but-for comparison. What would prices --</p> <p>22 what would have output have been but for the</p> <p>23 conduct at hand?</p> <p>24 So there are trends, you know. So</p>                                                 | <p style="text-align: right;">Page 44</p> <p>1 conclusions about time series comparisons like</p> <p>2 you're describing.</p> <p>3 BY MR. RYBNICEK:</p> <p>4 Q. What incentive would a monopolist have</p> <p>5 to pass on the gas savings to consumers in</p> <p>6 that example?</p> <p>7 A. So if it's a pure monopolist and</p> <p>8 again, the textbook example, right, so they</p> <p>9 would -- the pass-through rate, right, would</p> <p>10 be very little. But if we had, you know,</p> <p>11 something that's not exactly a pure</p> <p>12 monopolist, there can be situations where</p> <p>13 there would be partial pass-through of those</p> <p>14 prices.</p> <p>15 So again, this is the pure monopolist,</p> <p>16 a single firm idealized example in our</p> <p>17 textbooks, you know, is an abstraction, right?</p> <p>18 So as soon as we have multiple firms pass</p> <p>19 through, in many economic models is not</p> <p>20 exactly equal to one. So if a cost changes</p> <p>21 the pass-through will not move one for one,</p> <p>22 but it will move in a fractional way.</p> <p>23 Q. So you can't look at price or outputs</p> <p>24 to determine whether a market is</p> |
| <p style="text-align: right;">Page 43</p> <p>1 those trends could be independent of the</p> <p>2 conduct that one is interested in, costs going</p> <p>3 down, costs going up, you know, things outside</p> <p>4 of the market. So it's very hard to say, you</p> <p>5 know, blanket statements like that.</p> <p>6 Q. Putting aside this "but-for" world,</p> <p>7 it's your opinion that prices going down are</p> <p>8 not an indication of a competitive market?</p> <p>9 MR. CHANG: Objection. Form.</p> <p>10 A. Prices can go down for many reasons,</p> <p>11 so that alone is not sufficient to establish</p> <p>12 that the market is becoming more or less</p> <p>13 competitive.</p> <p>14 Like -- let me give you an example.</p> <p>15 Right. So let's say we have a market that is</p> <p>16 anticompetitive, not competitive, a monopoly</p> <p>17 market, but there is a certain input into that</p> <p>18 market, like gasoline, and that gasoline is an</p> <p>19 important input for the product market at</p> <p>20 hand. Prices could reflect the changes in the</p> <p>21 price of gasoline over time, and that</p> <p>22 sometimes can go up, sometimes can go down.</p> <p>23 And so, you know, we have to worry</p> <p>24 about the underlying trends to draw any</p> | <p style="text-align: right;">Page 45</p> <p>1 competitive --</p> <p>2 A. No, no. Just to clarify, it's not</p> <p>3 sufficient is what I'm trying to answer to</p> <p>4 your questions.</p> <p>5 MR. CHANG: Professor, let --</p> <p>6 THE WITNESS: I'm sorry.</p> <p>7 MR. CHANG: -- let our</p> <p>8 questioner ask his question, then you can</p> <p>9 answer. He'll do his best to not cut you off</p> <p>10 either.</p> <p>11 THE WITNESS: I'm sorry.</p> <p>12 BY MR. RYBNICEK:</p> <p>13 Q. No. That is a helpful clarification.</p> <p>14 I wasn't suggesting that it was sufficient.</p> <p>15 My question was are decreasing prices</p> <p>16 indicative of a competitive market, not</p> <p>17 dispositive?</p> <p>18 A. That would be a -- yeah, I agree with</p> <p>19 that. That's a place to start. But, of</p> <p>20 course, we'd have to understand the underlying</p> <p>21 institution and the reasons for why prices are</p> <p>22 decreasing and do a much more thorough</p> <p>23 context-specific analysis.</p> <p>24 Q. And the same question but with respect</p>                                                                                                           |



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| <p style="text-align: right;">Page 46</p> <p>1 to output. Is increasing output indicative of</p> <p>2 a competitive market, not necessarily</p> <p>3 dispositive?</p> <p>4 A. Yeah, I would agree with that, with</p> <p>5 the same caveat that I just gave. We have to</p> <p>6 look at the underlying reasons for that.</p> <p>7 Now, there are examples in the</p> <p>8 economic literature where even that is not 100</p> <p>9 percent clear-cut where we can have expansions</p> <p>10 of output even when a firm is price</p> <p>11 discriminating. In fact, Hal Varian, Google's</p> <p>12 chief economist, famously wrote about this in</p> <p>13 the "American Economic Review" in a paper in</p> <p>14 the 19- -- I think 1986. So that just, I</p> <p>15 think, is by way of pointing out that we</p> <p>16 really have to think carefully about the</p> <p>17 context at hand.</p> <p>18 Like, you know, I can give you the</p> <p>19 intuition of what kind of the varying insight</p> <p>20 is, which is if I am, you know, thinking</p> <p>21 about -- let's just say I'm -- let me see if</p> <p>22 can get this right.</p> <p>23 Let's say I'm providing milk to</p> <p>24 schoolchildren, okay, at an elementary school,</p>                                           | <p style="text-align: right;">Page 48</p> <p>1 offering prices and seeing who's willing to</p> <p>2 buy. And if that is too high of a price, the</p> <p>3 price goes down a little bit and people see</p> <p>4 who's willing to buy, so on and so forth. So</p> <p>5 under that description, you could say it is</p> <p>6 like a price discrimination idea.</p> <p>7 And another thought that comes to mind</p> <p>8 for your question is thinking about auction</p> <p>9 markets.</p> <p>10 So there's literature that relates</p> <p>11 pricing in auctions. In fact, Myerson's</p> <p>12 optimal auction paper that is cited in many of</p> <p>13 the expert reports here has been reinterpreted</p> <p>14 by economists Jeremy Bulow and John Roberts in</p> <p>15 a very famous article in 1989 showing that</p> <p>16 monopolists' pricing problem is very closely</p> <p>17 related to Myerson's optimal auction problem.</p> <p>18 So it really depends on what you mean by</p> <p>19 "price discrimination markets."</p> <p>20 Q. I'd like to go back to this idea of</p> <p>21 how to identify whether conduct is</p> <p>22 anticompetitive because I'm still struggling</p> <p>23 to understand your opinion on that.</p> <p>24 Do you look at foreclosure to</p> |
| <p style="text-align: right;">Page 47</p> <p>1 right, and we set up a milk cartel, and I have</p> <p>2 the ability to charge different prices to</p> <p>3 elementary schools and to folks at the grocery</p> <p>4 store. Then it's possible for me to price</p> <p>5 discriminate in a way that leads to more</p> <p>6 output. And that is an example of having</p> <p>7 power over price. So that -- I'm not -- I</p> <p>8 believe -- I would have to look again, but</p> <p>9 Varian's '86 article, I think, has an example</p> <p>10 along those lines.</p> <p>11 Q. Are any of the markets in ad tech</p> <p>12 price discrimination markets?</p> <p>13 A. I'm not sure I understand what the</p> <p>14 word "price discrimination markets" means. So</p> <p>15 one possible definition of "price</p> <p>16 discrimination markets" is a market where</p> <p>17 sellers are able to extract the willingness to</p> <p>18 pay across heterogeneous consumers in the</p> <p>19 market. So if you think about a seller that</p> <p>20 is pricing down its demand curve, then that is</p> <p>21 a form of price discrimination.</p> <p>22 So you could think, for instance, of</p> <p>23 the waterfall that used to be common in</p> <p>24 display advertising markets as, you know,</p> | <p style="text-align: right;">Page 49</p> <p>1 determine whether conduct is</p> <p>2 anticompetitive?</p> <p>3 A. If by "foreclosure," you mean the</p> <p>4 exclusion of competitors, yes.</p> <p>5 Q. And did you -- in either of the</p> <p>6 reports, did you analyze foreclosure?</p> <p>7 A. My assignment was to look at market</p> <p>8 design aspects here. So the example, say, of</p> <p>9 dynamic allocation where AdX is able to get a</p> <p>10 look at transactions as preventing other</p> <p>11 exchanges from being able to compete, so that</p> <p>12 is excluding competition. So there are parts</p> <p>13 of my report that touch on these issues.</p> <p>14 Q. If dynamic allocation is akin -- if we</p> <p>15 can go back to your housekeeping example -- to</p> <p>16 the new vacuum cleaner, right, it was an</p> <p>17 innovation by Google; is that fair?</p> <p>18 MR. CHANG: Objection. Form.</p> <p>19 A. The idea of real-time pricing was not</p> <p>20 a Google innovation. I wouldn't call it an</p> <p>21 innovation to place Google's AdX exchange at</p> <p>22 the top of a queue without giving publishers</p> <p>23 choices about whether AdX should be</p> <p>24 prioritized in the waterfall or not. I don't</p>                  |

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| <p style="text-align: right;">Page 50</p> <p>1 know if I would agree with your description of</p> <p>2 it as an innovation.</p> <p>3 BY MR. RYBNICEK:</p> <p>4 Q. So you disagree that dynamic</p> <p>5 allocation was an innovation?</p> <p>6 MR. CHANG: Objection. Form.</p> <p>7 A. I thought you had asked about whether</p> <p>8 it was an innovation by Google.</p> <p>9 BY MR. RYBNICEK:</p> <p>10 Q. Who is it an innovation by?</p> <p>11 A. Well, by dynamic allocation, there's</p> <p>12 kind of some essential ingredients. So one is</p> <p>13 the use of real-time prices. So having the</p> <p>14 signals that sellers get reflect underlying</p> <p>15 real-time information in the marketplace. And</p> <p>16 my understanding is that was not an invention</p> <p>17 of Google's. So that's one part of dynamic</p> <p>18 allocation because AdX is using real-time bid</p> <p>19 information.</p> <p>20 The other part of dynamic allocation</p> <p>21 is the sequencing or the priority orders of</p> <p>22 folks using, you know, DFP to sell their ads.</p> <p>23 So that was Google's innovation to -- I</p> <p>24 wouldn't call it an innovation, but that was</p>                  | <p style="text-align: right;">Page 52</p> <p>1 MR. CHANG: Objection. Form.</p> <p>2 A. So Google used dynamic allocation, but</p> <p>3 Google also used that idea as part of, you</p> <p>4 know, DoubleClick. DoubleClick had a form of</p> <p>5 dynamic allocation prior to Google purchasing</p> <p>6 DoubleClick. So it dates at least until</p> <p>7 DoubleClick, but it may even be before then.</p> <p>8 I don't recall at this moment.</p> <p>9 BY MR. RYBNICEK:</p> <p>10 Q. So DoubleClick created dynamic</p> <p>11 allocation?</p> <p>12 MR. CHANG: Objection. Form.</p> <p>13 A. I just want to be very precise about</p> <p>14 what we're calling dynamic allocation, right?</p> <p>15 So there is the sequencing order of sources of</p> <p>16 demands, let's call it. And so there's also</p> <p>17 allowing certain exchanges -- AdX in the case</p> <p>18 of Google -- to go first or go near the top of</p> <p>19 the sequencing. So DoubleClick had a version</p> <p>20 of that. Google, you know, had a version of</p> <p>21 that as well.</p> <p>22 BY MR. RYBNICEK:</p> <p>23 Q. And is it fair to call that an</p> <p>24 innovation from the waterfall system?</p>                                                                                                         |
| <p style="text-align: right;">Page 51</p> <p>1 Google's decision to put AdX at the top of</p> <p>2 the -- I should say near the top of the</p> <p>3 waterfall.</p> <p>4 Q. And so in your view, where did dynamic</p> <p>5 allocation come from? What was the genesis?</p> <p>6 MR. CHANG: Objection. Form.</p> <p>7 A. My read of the record is there was</p> <p>8 interest in the marketplace to have more</p> <p>9 real-time information about prices. There was</p> <p>10 already providers trying to offer that kind of</p> <p>11 information to publishers.</p> <p>12 As a publisher, you know, there's a</p> <p>13 strong incentive to want to have accurate</p> <p>14 information and not have your slots -- your</p> <p>15 inventory be sold using, you know, outdated</p> <p>16 static, you know, line item information,</p> <p>17 static estimates of CPMs. So, you know,</p> <p>18 there's this underlying trend towards that.</p> <p>19 And now I've lost my thread. I'm so</p> <p>20 sorry. Can you restate you question?</p> <p>21 BY MR. RYBNICEK:</p> <p>22 Q. I was just curious what your</p> <p>23 understanding is of which firm was the first</p> <p>24 to use dynamic allocation?</p> | <p style="text-align: right;">Page 53</p> <p>1 A. I wouldn't call it an innovation</p> <p>2 because in some respects it's taking away</p> <p>3 publisher's choice because an essential part</p> <p>4 of Google's version of dynamic allocation is</p> <p>5 putting AdX near the top of the waterfall, and</p> <p>6 a true innovation would allow publishers the</p> <p>7 ability to access real-time bids wherever in</p> <p>8 the waterfall they wanted to.</p> <p>9 Q. Was the waterfall an efficient</p> <p>10 mechanism?</p> <p>11 MR. CHANG: Objection. Form.</p> <p>12 A. The waterfall, I wouldn't call it an</p> <p>13 efficient allocation mechanism because it's</p> <p>14 sequential. So there are sources of demands</p> <p>15 that might have a higher willingness to pay or</p> <p>16 might be better matches that could be further</p> <p>17 down the waterfall that we don't reach.</p> <p>18 Because of the sequentiality, we end up</p> <p>19 transacting with a party that's earlier in the</p> <p>20 waterfall, that has a higher priority in the</p> <p>21 waterfall, so we miss the potential gains from</p> <p>22 trade. So that's bad for publishers, and</p> <p>23 that's potentially bad for advertisers, in</p> <p>24 particular, the advertiser who is willing to</p> |



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| <p style="text-align: right;">Page 54</p> <p>1 pay more but did not get to transact because</p> <p>2 they were lower down.</p> <p>3 BY MR. RYBNICEK:</p> <p>4 Q. And that existed before Google's</p> <p>5 acquisition of DoubleClick, correct?</p> <p>6 A. The waterfall, correct, yes.</p> <p>7 Q. And you said it was an inefficient</p> <p>8 system, the waterfall. Was the market</p> <p>9 competitive at the time?</p> <p>10 MR. CHANG: Objection. Form.</p> <p>11 A. I would say we did not maximize the</p> <p>12 gains from trade because of the waterfall. So</p> <p>13 at that time -- I haven't done a deep analysis</p> <p>14 of other indicia, you know, competition from</p> <p>15 that time period, but as a market design</p> <p>16 economist, I would not have structured things</p> <p>17 that way. And, in fact, that's why the market</p> <p>18 evolved and moved towards more simultaneous</p> <p>19 bidding through things like header bidding.</p> <p>20 In fact, if we think about the</p> <p>21 emergence of header bidding, as I discuss in</p> <p>22 the report, many people in the industry talk</p> <p>23 about, you know, the desire for market</p> <p>24 participants to have simultaneous trades with</p> | <p style="text-align: right;">Page 56</p> <p>1 Q. Sorry. Maybe I'm not being clear.</p> <p>2 But prior to Google's acquisition of</p> <p>3 DoubleClick, when the waterfall existed, was</p> <p>4 the market competitive?</p> <p>5 MR. CHANG: Objection. Form.</p> <p>6 A. Prior -- so this is back to, like,</p> <p>7 2008, the time period?</p> <p>8 BY MR. RYBNICEK:</p> <p>9 Q. Yes.</p> <p>10 A. I'd have to think more about that.</p> <p>11 You know, that wasn't really my assignment</p> <p>12 here. My assignment was to look at Google's</p> <p>13 conduct. So you're asking me about a period</p> <p>14 prior to Google's involvement in this</p> <p>15 marketplace, so I haven't undertaken a deep</p> <p>16 study of that issue.</p> <p>17 Q. Okay. But you've testified that</p> <p>18 waterfall's inefficient.</p> <p>19 A. Uh-huh.</p> <p>20 Q. And on a number of occasions, you've</p> <p>21 said inefficiency is an indication of less</p> <p>22 than competitive -- or a less competitive</p> <p>23 market --</p> <p>24 A. Uh-huh.</p>                                                                    |
| <p style="text-align: right;">Page 55</p> <p>1 real-time information and why Google's use of</p> <p>2 dynamic allocation or enhanced dynamic</p> <p>3 allocation precipitated header bidding.</p> <p>4 So header bidding, I would say, is a</p> <p>5 more efficient market-clearing system than the</p> <p>6 waterfall because it's simultaneous rather</p> <p>7 than sequential.</p> <p>8 BY MR. RYBNICEK:</p> <p>9 Q. That's helpful. But during the period</p> <p>10 that the waterfall existed, was the market</p> <p>11 competitive?</p> <p>12 MR. CHANG: Objection. Form.</p> <p>13 A. I don't believe so because Google was</p> <p>14 able to impose that -- its product, AdX,</p> <p>15 appears first in the waterfall, excluding</p> <p>16 competition from other exchanges. So one</p> <p>17 measure of whether something is competitive is</p> <p>18 whether there's a participant in the market</p> <p>19 who is able to exclude competition. And so</p> <p>20 the very nature of dynamic allocation is</p> <p>21 Google has steered volume to AdX without</p> <p>22 allowing publishers the choice. So I wouldn't</p> <p>23 call that a competitive process.</p> <p>24 BY MR. RYBNICEK:</p>                                   | <p style="text-align: right;">Page 57</p> <p>1 Q. -- right?</p> <p>2 A. Yes.</p> <p>3 Q. The waterfall -- prior to Google's</p> <p>4 acquisition of DoubleClick, the waterfall</p> <p>5 existed, and you have testified that it was</p> <p>6 inefficient.</p> <p>7 Doesn't that mean that it was also not</p> <p>8 competitive?</p> <p>9 MR. CHANG: Objection. Form.</p> <p>10 A. We have to judge what was happening in</p> <p>11 that very early period relative to what are</p> <p>12 the other options in the market.</p> <p>13 So back in 2008, it's my understanding</p> <p>14 that real-time bidding was not very common,</p> <p>15 that DoubleClick's version of waterfall was</p> <p>16 different than Google's version of dynamic</p> <p>17 allocation.</p> <p>18 So as soon as we introduced real-time</p> <p>19 bidding as a new technology, right, you could</p> <p>20 say, the waterfall, you know, because of its</p> <p>21 sequential nature, becomes inefficient.</p> <p>22 There's an alternative.</p> <p>23 And what I'm not opining on, because</p> <p>24 it wasn't my assignment, is what the market</p> |

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| <p style="text-align: right;">Page 58</p> <p>1 looked like before Google's participation</p> <p>2 with -- you know, when it was just</p> <p>3 DoubleClick.</p> <p>4 BY MR. RYBNICEK:</p> <p>5 Q. So inefficiency is measured by what is</p> <p>6 available at the time?</p> <p>7 A. I mean, yes.</p> <p>8 So it would be efficient if none of us</p> <p>9 had ulcers, right? But if we go 50 years ago</p> <p>10 and there were no drugs to treat ulcers, then</p> <p>11 we would look at 50 years ago and say, Well,</p> <p>12 there was no drug to treat ulcers. So if you</p> <p>13 have an ulcer, that's the outcome. There's no</p> <p>14 way to make you better without making someone</p> <p>15 else worse off, yes.</p> <p>16 So definitions of efficiency depend on</p> <p>17 the production possibility set and what</p> <p>18 technologies exist at the time, yes.</p> <p>19 Q. So it would be unfair to criticize a</p> <p>20 firm for not undertaking steps that aren't yet</p> <p>21 prevalent in the market?</p> <p>22 MR. CHANG: Objection. Form.</p> <p>23 A. Again, at that level of generality,</p> <p>24 it's hard to answer either way. So we would</p>               | <p style="text-align: right;">Page 60</p> <p>1 same time, and there is a sequential sales</p> <p>2 mechanism, it's not just me. I think Google's</p> <p>3 experts also think that having simultaneous</p> <p>4 sales are more efficient.</p> <p>5 But if the world is such that that</p> <p>6 technology does not exist, so the only</p> <p>7 technology that we have is a sequential sales</p> <p>8 technology, then to judge whether that's</p> <p>9 efficient or not, the next question I would</p> <p>10 ask is do the publishers, do the sellers in</p> <p>11 the market have the ability to set the</p> <p>12 priority order in a way that suits their</p> <p>13 objectives to maximize whatever goal they're</p> <p>14 seeking to?</p> <p>15 And if the answer to that is yes, then</p> <p>16 I would ask is there a different choice that</p> <p>17 the publishers could have made that would have</p> <p>18 achieved their objectives and they were</p> <p>19 allowed to take that different choice but</p> <p>20 chose to prioritize sources of demand in a way</p> <p>21 that they did, then I would say that that is</p> <p>22 not a case for saying there's a market</p> <p>23 failure.</p> <p>24 So if they have unconstrained choice</p> |
| <p style="text-align: right;">Page 59</p> <p>1 have to look at the specific context of what</p> <p>2 steps they took, under what situations, what</p> <p>3 their intent was, what the effects of the</p> <p>4 steps were, was it used to suppress</p> <p>5 competitors and exclude competitors or not to</p> <p>6 give a proper answer to that question.</p> <p>7 At this level of abstraction, it's not</p> <p>8 very easy to.</p> <p>9 Q. Do you know all those things that you</p> <p>10 just mentioned with respect to the waterfall</p> <p>11 prior to Google's DoubleClick acquisition?</p> <p>12 A. Could you restate the question? I</p> <p>13 want to make sure I understand.</p> <p>14 Q. You were very willing to say that,</p> <p>15 with respect to the waterfall, it's not</p> <p>16 necessarily inefficient because that's the</p> <p>17 technology that existed.</p> <p>18 Is that fair?</p> <p>19 A. Can we be precise about the --</p> <p>20 Q. Please.</p> <p>21 A. -- timing of what technology existed?</p> <p>22 So if real-time bidding with live</p> <p>23 information existed, it were possible to bring</p> <p>24 together multiple sources of demand at the</p> | <p style="text-align: right;">Page 61</p> <p>1 with full information and they settled on</p> <p>2 selling sequentially when there was no other</p> <p>3 option, then that is publishers acting in</p> <p>4 their own best interest.</p> <p>5 Q. If a firm competing in the ad tech</p> <p>6 sector makes an innovation that makes a market</p> <p>7 more efficient, at least for it, is it your</p> <p>8 view that that innovation needs to be shared</p> <p>9 broadly?</p> <p>10 MR. CHANG: Objection. Form.</p> <p>11 A. It depends on the context again.</p> <p>12 So if that innovation is -- the not</p> <p>13 sharing of that innovation is used to exclude</p> <p>14 competitors and rivals, then I see a problem</p> <p>15 with that. If it's not used in that way, then</p> <p>16 I would say there's not a problem.</p> <p>17 BY MR. RYBNICEK:</p> <p>18 Q. Is there an obligation for a</p> <p>19 competitor to help its rival?</p> <p>20 MR. CHANG: Objection. Form.</p> <p>21 A. I would say that depends on the</p> <p>22 context.</p> <p>23 So if there's a competitor that is</p> <p>24 raising its rival's costs, for instance, in a</p>                                                                                               |

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| <p style="text-align: right;">Page 62</p> <p>1 way to exclude competition from the</p> <p>2 competitor, there's a problem with that, and</p> <p>3 that can have adverse consequences on the</p> <p>4 market.</p> <p>5 BY MR. RYBNICEK:</p> <p>6 Q. Sorry. Going back to the example we</p> <p>7 were working with, which is one in which a</p> <p>8 firm makes an innovation and that innovation</p> <p>9 is a tool it uses to make the market more</p> <p>10 efficient for itself, is it anticompetitive</p> <p>11 for that firm not to share that innovation</p> <p>12 more broadly?</p> <p>13 MR. CHANG: Objection. Form.</p> <p>14 A. I believe I answered that question.</p> <p>15 So it depends on the context.</p> <p>16 If the firm is not sharing that</p> <p>17 innovation in an effort to exclude</p> <p>18 competition, exclude the ability for rivals to</p> <p>19 compete on the merits, then there's a problem</p> <p>20 with that.</p> <p>21 BY MR. RYBNICEK:</p> <p>22 Q. But doesn't a competitor always try to</p> <p>23 exclude its competitors?</p> <p>24 Strike that.</p>                                                                                                        | <p style="text-align: right;">Page 64</p> <p>1 effort to exclude competition, to not compete</p> <p>2 on the merits, then it can be anticompetitive.</p> <p>3 Q. So I'm sorry to do this, but going</p> <p>4 back to our housekeeper example --</p> <p>5 A. Okay.</p> <p>6 Q. -- I think we talked about how if a</p> <p>7 housekeeper made an innovation, had some new</p> <p>8 tool, she wouldn't be required or he wouldn't</p> <p>9 be required to share that with competitors.</p> <p>10 MR. CHANG: Objection. Form.</p> <p>11 A. The housekeeper has the right, because</p> <p>12 it's in a competitive market here, to not</p> <p>13 share the new, you know, vacuum cleaner</p> <p>14 technology or whatever it was that we</p> <p>15 discussed with their competitors.</p> <p>16 But if the housekeeper were doing</p> <p>17 that, if they were a dominant housekeeper, for</p> <p>18 instance, that was blocking other housekeepers</p> <p>19 from competing using that technology, then</p> <p>20 there could be a problem.</p> <p>21 BY MR. RYBNICEK:</p> <p>22 Q. I see. So --</p> <p>23 MR. CHANG: Counsel, I don't</p> <p>24 mean to interrupt you at all. Just whenever</p> |
| <p style="text-align: right;">Page 63</p> <p>1 Doesn't a firm always try to exclude</p> <p>2 its competitors?</p> <p>3 A. There is kind of competition on the</p> <p>4 merits, and there is competition that's not on</p> <p>5 the merits, so excluding competition depending</p> <p>6 on the specific context at hand.</p> <p>7 One way I could try to compete with my</p> <p>8 competitors is by lowering my price, and that</p> <p>9 is a great thing about competition. If I'm a</p> <p>10 firm and I want to outcompete my rival, I</p> <p>11 would lower my price, and that would attract</p> <p>12 more demand to my firm compared to my rival,</p> <p>13 so that is something that we like.</p> <p>14 Did I answer your question? I'm</p> <p>15 sorry. If I didn't, could you please restate</p> <p>16 it?</p> <p>17 Q. My question was simply, if a firm</p> <p>18 makes an innovation, is it anticompetitive if</p> <p>19 it keeps that innovation to itself?</p> <p>20 A. If the firm is using that innovation</p> <p>21 to exclude competitors, it can be</p> <p>22 anticompetitive.</p> <p>23 The innovations, the not allowing</p> <p>24 other folks to access that innovation in an</p> | <p style="text-align: right;">Page 65</p> <p>1 you get to a good stopping point. We've been</p> <p>2 going for over an hour now.</p> <p>3 MR. RYBNICEK: Oh, that's fair.</p> <p>4 Just a few more questions, and then we'll wrap</p> <p>5 this up and take a break.</p> <p>6 BY MR. RYBNICEK:</p> <p>7 Q. So you're -- am I correct in</p> <p>8 understanding that you're saying a dominant</p> <p>9 firm has a special obligation to share its</p> <p>10 innovations with competitors?</p> <p>11 MR. CHANG: Objection. Form.</p> <p>12 A. It depends on the context.</p> <p>13 If it's venting -- if a dominant firm</p> <p>14 is blocking competition by not sharing its</p> <p>15 innovation, then it is excluding competition,</p> <p>16 which is bad for the market.</p> <p>17 BY MR. RYBNICEK:</p> <p>18 Q. And what -- what informs these views</p> <p>19 that you have about a dominant firm</p> <p>20 potentially having to share its innovation</p> <p>21 with its competitors?</p> <p>22 A. I'm coming to you with my expertise as</p> <p>23 an economist.</p> <p>24 Q. Okay. Is this -- is it -- do you</p>                                                                     |

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| <p style="text-align: right;">Page 66</p> <p>1 teach in your economics courses that a</p> <p>2 dominant firm has an obligation to share its</p> <p>3 innovations with competitors?</p> <p>4 MR. CHANG: Objection. Form.</p> <p>5 A. I don't cover Trinko and these kinds</p> <p>6 of topics in my --</p> <p>7</p> <p>8 (Stenographer clarification.)</p> <p>9</p> <p>10 THE WITNESS: Oh, sorry.</p> <p>11 Trinko, it's a legal case.</p> <p>12 A. I'm an economist, so I don't have the</p> <p>13 nuances of legal cases like the one that you</p> <p>14 might have in mind here. So what I'm</p> <p>15 interested in is, you know, in my market</p> <p>16 design classes, figuring out how to make</p> <p>17 competition work. And so any actions that get</p> <p>18 in the way of harnessing competitive forces,</p> <p>19 including those by dominant firms that take</p> <p>20 actions to exclude competition, are</p> <p>21 problematic from the perspective of market</p> <p>22 design.</p> <p>23 BY MR. RYBNICEK:</p> <p>24 Q. Okay. I know there's been -- I've got</p>                                                                                                                                              | <p style="text-align: right;">Page 68</p> <p>1 BY MR. RYBNICEK:</p> <p>2 Q. All right. And then my last question</p> <p>3 was, because I like this housekeeper example</p> <p>4 so much, if the housekeeper makes an</p> <p>5 innovation and his or her rival exits because</p> <p>6 it is not as efficient, is that</p> <p>7 anticompetitive?</p> <p>8 A. In that example, no, it's not. That</p> <p>9 is what Joseph Schumpeter talked about as</p> <p>10 creative destruction firms innovating. And</p> <p>11 that causes entry and exit, and that's, you</p> <p>12 know, in a dynamic model, why competition</p> <p>13 leads to productivity improvements.</p> <p>14 MR. RYBNICEK: Okay. I'm happy</p> <p>15 to take a break now.</p> <p>16 MR. CHANG: Sounds good.</p> <p>17 THE VIDEOGRAPHER: The time is</p> <p>18 10:22. We're off the record 10:22 a.m.</p> <p>19</p> <p>20</p> <p>21 (Recess taken from 10:22 a.m.</p> <p>22 to 10:42 a.m.)</p> <p>23</p> <p>24</p>                                  |
| <p style="text-align: right;">Page 67</p> <p>1 two questions.</p> <p>2 One is you raised Trinko. So putting</p> <p>3 aside a scenario in which a firm has been</p> <p>4 dealing with its competitors, a firm makes a</p> <p>5 new innovation and has not been sharing that</p> <p>6 with its competitors. Do you -- is it still</p> <p>7 your view that a dominant firm may be required</p> <p>8 to share that with its competitors; otherwise,</p> <p>9 their conduct would be anticompetitive?</p> <p>10 MR. CHANG: Objection. Form.</p> <p>11 A. It would depend on the specifics of</p> <p>12 the situation. So if the dominant firm's</p> <p>13 unwillingness to share that innovation is in</p> <p>14 service of the exclusion of competition, then</p> <p>15 there's a potential problem.</p> <p>16 BY MR. RYBNICEK:</p> <p>17 Q. So it's intent?</p> <p>18 MR. CHANG: Objection. Form.</p> <p>19 A. Not just intent. It's also other</p> <p>20 aspects of the episode at hand. And this is a</p> <p>21 very abstract discussion, so it's hard for me</p> <p>22 to be more precise. But it's also the effect</p> <p>23 of the conduct and whether the conduct</p> <p>24 succeeds in excluding competition or not.</p> | <p style="text-align: right;">Page 69</p> <p>1 (Exhibit No. 3 marked for</p> <p>2 identification.)</p> <p>3</p> <p>4 THE VIDEOGRAPHER: We are back</p> <p>5 on the record. The time is 10:42.</p> <p>6 BY MR. RYBNICEK:</p> <p>7 Q. Great. Just two quick things. One,</p> <p>8 at the beginning of the deposition,</p> <p>9 Professor Pathak, you handed me a document</p> <p>10 with the typos to your -- typos you've</p> <p>11 identified in your reports. I'm just going to</p> <p>12 mark that as Exhibit 3 so we can all keep</p> <p>13 track of it.</p> <p>14 Then, second, we just took a break.</p> <p>15 Did you discuss any substance of your</p> <p>16 testimony with your counsel?</p> <p>17 MR. CHANG: Objection. I'm</p> <p>18 going to instruct the witness not to answer</p> <p>19 based on the expert stipulation.</p> <p>20 BY MR. RYBNICEK:</p> <p>21 Q. Are you going to follow your</p> <p>22 attorney's instruction?</p> <p>23 A. Yes.</p> <p>24 Q. So do your reports contain any</p> |

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| <p style="text-align: right;">Page 70</p> <p>1 opinions about Google's market power? Strike</p> <p>2 that.</p> <p>3 Do your reports contain any opinions</p> <p>4 about whether Google has market power?</p> <p>5 A. So in my report, I rely on Professor</p> <p>6 Joshua Gans' analysis of market power. But in</p> <p>7 my role as a market design economist, I looked</p> <p>8 at aspects of Google's behavior in the markets</p> <p>9 at hand. And as a market design economist,</p> <p>10 one of the starting points is to look at</p> <p>11 whether the market is inefficient, and a</p> <p>12 primary reason why outcomes can be inefficient</p> <p>13 is because of market power. So some of my</p> <p>14 analysis overlaps with what Professor Gans</p> <p>15 did, so I also did some independent analysis</p> <p>16 of those issues.</p> <p>17 Q. And did you reach conclusions about</p> <p>18 whether Google has monopoly power, and is that</p> <p>19 contained in your report?</p> <p>20 A. The specific conclusions about</p> <p>21 Google's monopoly power are laid out in</p> <p>22 Professor Gans' reports. But in my analysis</p> <p>23 and understanding of the participants'</p> <p>24 incentives from the perspective of market</p> | <p style="text-align: right;">Page 72</p> <p>1 question. Maybe I'll put it this way. Where</p> <p>2 in your report is your opinion -- your</p> <p>3 independent opinion about whether Google has</p> <p>4 market power or monopoly power?</p> <p>5 A. My assignment was to look at Google's</p> <p>6 conducts and incentives to undertake several</p> <p>7 of the conducts that are described in my</p> <p>8 report. And had Google not had market power</p> <p>9 for several of those conducts, I do not</p> <p>10 believe Google would have been able to</p> <p>11 implement those conducts in a way to exclude</p> <p>12 participants from the market. So it's kind of</p> <p>13 the premise of my analysis. Coming at the</p> <p>14 question from market design lenses, there are</p> <p>15 problems that have as a root cause Google's</p> <p>16 market power.</p> <p>17 Q. Can you look at Paragraph 8 of your</p> <p>18 opening report.</p> <p>19 A. I'm going to do the binder version.</p> <p>20 Okay?</p> <p>21 Q. That's perfectly fine.</p> <p>22 A. Let me see Paragraph 8 here.</p> <p>23 Okay.</p> <p>24 Q. Can you read the first two sentences.</p> |
| <p style="text-align: right;">Page 71</p> <p>1 design, I saw that there are several indicia</p> <p>2 of the presence of market power such as high</p> <p>3 switching costs, such as barriers to entry,</p> <p>4 such as network externalities. Those are all</p> <p>5 things that I came upon in reaching the</p> <p>6 opinions in my report.</p> <p>7 Q. I'm sorry. This should be a very easy</p> <p>8 question. Does your report contain an opinion</p> <p>9 about whether Google has monopoly power?</p> <p>10 MR. CHANG: Objection. Form.</p> <p>11 So there's specific reliance in</p> <p>12 my report that comes from Professor Joshua</p> <p>13 Gans. But in my own independent review as a</p> <p>14 market design economist, my second lecture in</p> <p>15 my undergraduate market design class, I</p> <p>16 discuss why, reasons market designers think</p> <p>17 about the role for design, and my lecture</p> <p>18 slide talks about the presence of market</p> <p>19 power. So my report looks at those issues,</p> <p>20 and the specific reliance is coming from</p> <p>21 Professor Gans, but my analysis overlaps, as I</p> <p>22 just said.</p> <p>23 BY MR. RYBNICEK:</p> <p>24 Q. I'm just trying to ask a very simple</p>         | <p style="text-align: right;">Page 73</p> <p>1 A. "I have spoken to Professor Gans</p> <p>2 regarding his analysis of the relevant</p> <p>3 markets, market power, and anticompetitive</p> <p>4 effects. I rely on Professor Gans' findings</p> <p>5 on market power and market definitions."</p> <p>6 Q. Is this a true statement?</p> <p>7 A. Yes.</p> <p>8 Q. And it remains accurate?</p> <p>9 A. Yes.</p> <p>10 Q. Are you relying on any other opinions</p> <p>11 for your conclusion about market power and</p> <p>12 market definition?</p> <p>13 A. As I said, the methodological approach</p> <p>14 of market design economics is to diagnose</p> <p>15 market failures, and I did an independent</p> <p>16 review of reasons for market failure in</p> <p>17 this -- in the relevant markets. And, you</p> <p>18 know, I think we could say I do not solely</p> <p>19 rely on Professor Gans' findings on market</p> <p>20 power.</p> <p>21 Q. Point me to where in your report you</p> <p>22 conduct a market definition exercise.</p> <p>23 A. I was talking about market power.</p> <p>24 Q. The sentence you just read says</p>                       |



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| <p style="text-align: right;">Page 74</p> <p>1 "market power and market definition,"</p> <p>2 correct?</p> <p>3 A. The second sentence here, yes. Yes.</p> <p>4 Q. And you --</p> <p>5 A. So I don't -- I don't do a separate</p> <p>6 analysis of market definition in my report.</p> <p>7 Q. Okay. And so you completely rely on</p> <p>8 Professor Gans for that?</p> <p>9 A. Yes.</p> <p>10 Q. And you use his markets for your</p> <p>11 report?</p> <p>12 A. That's correct. I use his analysis of</p> <p>13 the markets that he's defined. I reviewed</p> <p>14 them. I discussed them with him. But I rely</p> <p>15 on him for market definition.</p> <p>16 Q. And now can you point me to where in</p> <p>17 your report you conclude that Google has</p> <p>18 monopoly power?</p> <p>19 A. When I describe some of the incentives</p> <p>20 underlying Google's conducts, it's my view</p> <p>21 that had Google not had market power, it could</p> <p>22 not have undertaken conducts -- for instance,</p> <p>23 I have a whole section in my report that's</p> <p>24 called restricting publisher choice. Let me</p>                                                                                                             | <p style="text-align: right;">Page 76</p> <p>1 I cite in my report, and I'm also looking at</p> <p>2 the effects of those actions.</p> <p>3 Q. Okay. Do you conclude in your report</p> <p>4 that Google had monopoly power?</p> <p>5 A. So, you know, specific reliance of my</p> <p>6 report on Professor Gans is that he is</p> <p>7 expressing the opinions about market power,</p> <p>8 but my assignment here was to look at things</p> <p>9 from this market design perspective that</p> <p>10 overlaps considerably with the questions of</p> <p>11 market power. So that -- that's how I've come</p> <p>12 at this.</p> <p>13 Q. Do you conclude in your report that</p> <p>14 Google has monopoly power?</p> <p>15 A. It's --</p> <p>16 MR. CHANG: Objection. Form.</p> <p>17 A. It's my opinion that Google would not</p> <p>18 have been able to do the conducts that I</p> <p>19 describe in my report had it not had monopoly</p> <p>20 power.</p> <p>21 BY MR. RYBNICEK:</p> <p>22 Q. So your conclusion about whether</p> <p>23 Google has monopoly power is based on your</p> <p>24 understanding that they engaged in the</p> |
| <p style="text-align: right;">Page 75</p> <p>1 tell you what section that is.</p> <p>2 Section 10, "Google's control over</p> <p>3 publisher inventory arising from tie [sic]</p> <p>4 enabled Google to consistently act against the</p> <p>5 interests of its publisher customers."</p> <p>6 So I believe that if Google did not</p> <p>7 have market power, it could not have</p> <p>8 undertaken the actions that are described in</p> <p>9 that section. The next section also talks</p> <p>10 about Google taking away choice from</p> <p>11 publishers. So that section is also relevant.</p> <p>12 Q. So your analysis is an effects-based</p> <p>13 analysis. You find an effect, and you're,</p> <p>14 from that, concluding there's market power; is</p> <p>15 that fair?</p> <p>16 A. Let me make sure I understand the</p> <p>17 question.</p> <p>18 So, I mean, my -- what I don't</p> <p>19 understand in the question is what the word</p> <p>20 "effects-based analysis" means. I'm looking</p> <p>21 at Google's actions, actions that are against</p> <p>22 the interests of its publishers in both those</p> <p>23 two sections, and I'm looking at how Google</p> <p>24 described those actions in the documents that</p> | <p style="text-align: right;">Page 77</p> <p>1 conduct; is that accurate?</p> <p>2 MR. CHANG: Objection. Form.</p> <p>3 A. That they engaged in the conduct, and</p> <p>4 the conduct was used to exclude competition</p> <p>5 and the effects of the conduct.</p> <p>6 BY MR. RYBNICEK:</p> <p>7 Q. Okay. And so we'll park the effects.</p> <p>8 But you didn't calculate market</p> <p>9 shares, correct?</p> <p>10 A. That's right. That's not in my</p> <p>11 report. That's in, I believe, Professor Gans'</p> <p>12 report.</p> <p>13 Q. And you didn't analyze switching</p> <p>14 costs, did you?</p> <p>15 A. I do talk about in my report the</p> <p>16 deposition of Arnaud Creput, the CEO of</p> <p>17 Equativ AdServer, who expressed that [REDACTED]</p> <p>18 [REDACTED] So that's</p> <p>19 the sense in which my analysis overlaps with</p> <p>20 these topics, Professor Gans also analyzes.</p> <p>21 Q. Did you analyze switching costs with</p> <p>22 respect to Professor Gans' candidate ad</p> <p>23 exchange market?</p> <p>24 A. I mean, there are parts of my report</p>                                           |

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| <p style="text-align: right;">Page 78</p> <p>1 that touch upon that topic. For instance, in<br/> 2 my report, I talk about the tie between DFP<br/> 3 and AdX and how that led participants to face<br/> 4 high switching costs of leaving AdX. So I<br/> 5 think, in my report, I talk about the<br/> 6 representative from Vox Media -- I believe his<br/> 7 name is Ryan Pauley -- and his account of why<br/> 8 [REDACTED]<br/> 9 [REDACTED]<br/> 10 So again, I touch upon these issues in<br/> 11 my report, but Professor Gans has his own<br/> 12 analysis of these topics.<br/> 13 Q. Without Professor Gans' analysis,<br/> 14 would you -- well, strike that.<br/> 15 You said on a couple of occasions that<br/> 16 your analysis overlaps with Professor Gans<br/> 17 with respect to anticompetitive effects and<br/> 18 market power. What do you mean by "overlaps"?<br/> 19 A. Well, one way to think about it is our<br/> 20 starting points. So Professor Gans is doing a<br/> 21 traditional competition policy analysis of<br/> 22 defining markets, talking about Brown Shoe<br/> 23 factors, doing the snip test, the hypothetical<br/> 24 monopolist test, and so on. I don't do that</p>         | <p style="text-align: right;">Page 80</p> <p>1 market power and the effects of Google's<br/> 2 conduct on competition. So I have my own<br/> 3 independent opinions on that that I describe<br/> 4 in my report.<br/> 5 BY MR. RYBNICEK:<br/> 6 Q. So if Professor Gans hadn't issued his<br/> 7 report, you would have the same conclusions<br/> 8 about market power, market definition, and<br/> 9 anticompetitive effects?<br/> 10 MR. CHANG: Objection. Form.<br/> 11 A. So let me think through that<br/> 12 hypothetical here.<br/> 13 So if Professor Gans had not<br/> 14 introduced his report -- I rely on him for<br/> 15 market definition. So in my analysis here, I<br/> 16 wasn't asked to do a market definition<br/> 17 analysis.<br/> 18 For market power -- so let's imagine<br/> 19 we had a market definition from somewhere<br/> 20 else. Then for market power, I have several<br/> 21 parts of my report talking about Google's<br/> 22 incentives to steer activity to the AdX<br/> 23 exchange, which, as I've said, I don't believe<br/> 24 a firm would be able to do successfully had it</p>                                 |
| <p style="text-align: right;">Page 79</p> <p>1 in my report.<br/> 2 My report's starting place is from<br/> 3 market design where in market design, market<br/> 4 design economists diagnose market failures and<br/> 5 study how the structure of -- or the design<br/> 6 rules, more precisely, generate market<br/> 7 failures. And so there's overlap there<br/> 8 because, as I said, one of the starting<br/> 9 places, one of the main reasons why we have<br/> 10 market failures involves market power and<br/> 11 anticompetitive conduct. But my analysis is,<br/> 12 you know, starting from a different place than<br/> 13 Professor Gans, where he's doing the more<br/> 14 traditional antitrust economics analysis.<br/> 15 Q. I guess the thing I'm struggling with<br/> 16 is you say very clearly in your report you<br/> 17 rely on Professor Gans for market power and<br/> 18 market definition as well as anticompetitive<br/> 19 effects -- conclusions. But now you're<br/> 20 telling me that you have your own opinions; is<br/> 21 that true?<br/> 22 MR. CHANG: Objection. Form.<br/> 23 A. Many of the issues underlying Google's<br/> 24 conduct as a market design economist speak to</p> | <p style="text-align: right;">Page 81</p> <p>1 not had market power.<br/> 2 So what I don't have in my report is<br/> 3 the traditional competition policy analysis of<br/> 4 market power that Gans undertakes. But I<br/> 5 reviewed what Professor Gans did in his<br/> 6 report, and I found no reason to disagree with<br/> 7 his approach.<br/> 8 BY MR. RYBNICEK:<br/> 9 Q. Let me -- I apologize. But we keep<br/> 10 talking about market power and monopoly power,<br/> 11 and I just want to be precise.<br/> 12 What do you understand monopoly power<br/> 13 to mean?<br/> 14 A. Monopoly power, the way I think about<br/> 15 it is it's substantial market power, so the<br/> 16 power over price, the ability to exclude<br/> 17 competition. So in the, you know -- when we<br/> 18 talk about monopoly in my class, which I<br/> 19 literally taught this last week, you know, we<br/> 20 work with models which are abstractions. So<br/> 21 the monopoly case is a single-firm case, and<br/> 22 that's why we think of monopolists as, you<br/> 23 know, substantial market power.<br/> 24 Q. And do you use the phrase "monopoly</p> |



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| <p style="text-align: right;">Page 82</p> <p>1 power" in your report?</p> <p>2 A. I don't remember off the top of my</p> <p>3 head.</p> <p>4 Q. There's no section in which you say, I</p> <p>5 conclude that Google has monopoly power; is</p> <p>6 that fair?</p> <p>7 A. I'm just looking at my section</p> <p>8 headings here. One section heading is "Google</p> <p>9 took away choice from publishers." So usually</p> <p>10 in competitive markets, the participants in</p> <p>11 the markets have unfettered choices. So the</p> <p>12 headers are consistent with that statement</p> <p>13 that you made. I'd have to look at my report</p> <p>14 very closely to see if there's a sentence that</p> <p>15 says what you said.</p> <p>16 Q. You don't know, sitting here today,</p> <p>17 whether or not you concluded explicitly that</p> <p>18 Google has monopoly power?</p> <p>19 MR. CHANG: Objection. Form.</p> <p>20 A. My assignment was to look at Google's</p> <p>21 incentives in the display advertising markets</p> <p>22 here, and I think you're asking me about a</p> <p>23 very particular sentence in the report. So I</p> <p>24 can't give you a precise answer about a</p> | <p style="text-align: right;">Page 84</p> <p>1 is that "I was asked to apply my expertise in</p> <p>2 market design to analyze the incentives</p> <p>3 motivating Google's conduct at issue in this</p> <p>4 case. Using market design principles, I</p> <p>5 compare Google's conduct with efficient</p> <p>6 functioning markets.</p> <p>7 "I've also been asked to apply my</p> <p>8 market design expertise to identify the nature</p> <p>9 of remedies that would restore competition. I</p> <p>10 do not provide conclusions about whether</p> <p>11 Google's conduct is anticompetitive, but I</p> <p>12 have been instructed to accept certain</p> <p>13 conclusions in this regard provided by</p> <p>14 Professor Joshua Gans, another expert retained</p> <p>15 by plaintiff states."</p> <p>16 So the reason why there's overlap is</p> <p>17 my assignment was to apply my market design</p> <p>18 expertise to analyze the incentives motivating</p> <p>19 Google's conduct and the market design</p> <p>20 toolbox.</p> <p>21 I think I've said this a couple of</p> <p>22 times today already. In my undergraduate</p> <p>23 class at MIT, when I teach market design, I</p> <p>24 start off by talking about why markets need to</p>                                        |
| <p style="text-align: right;">Page 83</p> <p>1 particular sentence of, you know, a</p> <p>2 100-plus-page report, but my view is Google is</p> <p>3 not able to do a lot of the conducts that I</p> <p>4 described here had it not had substantial</p> <p>5 market power or monopoly power.</p> <p>6 BY MR. RYBNICEK:</p> <p>7 Q. I appreciate that. I understand your</p> <p>8 testimony is that the conduct wouldn't have</p> <p>9 been possible without Google having monopoly</p> <p>10 power. I'm trying to understand whether or</p> <p>11 not you concluded explicitly that Google has</p> <p>12 monopoly power in your report and disclose</p> <p>13 that.</p> <p>14 A. Let me take a look at the sections.</p> <p>15 Just give me one second.</p> <p>16 Q. Was it your assignment to conclude</p> <p>17 whether -- to analyze whether Google has</p> <p>18 monopoly power and to reach a conclusion?</p> <p>19 A. The way that I -- well, let's take a</p> <p>20 look at my assignment, and then I can explain</p> <p>21 to you why Google's substantial market power</p> <p>22 and its conduct are relevant for that</p> <p>23 conclusion.</p> <p>24 So my assignment here in Paragraph 2</p> | <p style="text-align: right;">Page 85</p> <p>1 be designed and why there are issues. And the</p> <p>2 two leading cases are, first, there is market</p> <p>3 power. The second is we have a missing price.</p> <p>4 So when I'm looking at this from a</p> <p>5 market design lens, I am looking at why is it</p> <p>6 that Google restricted choice? Why is it that</p> <p>7 publishers did not have options? If we had a</p> <p>8 competitive market, if the market were not</p> <p>9 monopolist, then competitors -- I'm sorry --</p> <p>10 publishers could switch the products that</p> <p>11 they're using freely, but they did not, and</p> <p>12 that is why Google was able to restrict choice</p> <p>13 to steer volume to its exchange.</p> <p>14 So that's the sense in which my market</p> <p>15 design analysis overlaps with Professor Joshua</p> <p>16 Gans. But my assignment is this market design</p> <p>17 framework. It's not the traditional</p> <p>18 competition economist framework.</p> <p>19 Q. Okay. I think this helps.</p> <p>20 So as you read in Paragraph 8, your</p> <p>21 assignment was not to make findings on</p> <p>22 Google's -- strike that.</p> <p>23 As you read in Paragraph 8, your</p> <p>24 assignment was not to make conclusions about</p> |

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| <p style="text-align: right;">Page 86</p> <p>1 anticompetitive effects, correct?</p> <p>2 MR. CHANG: Objection. Form.</p> <p>3 MR. RYBNICEK: Sorry. I read</p> <p>4 the wrong paragraph, didn't I?</p> <p>5 BY MR. RYBNICEK:</p> <p>6 Q. Paragraph 2. As you read in</p> <p>7 Paragraph 2, your assignment was not to reach</p> <p>8 conclusions about whether Google's conduct was</p> <p>9 anticompetitive, correct?</p> <p>10 A. Yes, Paragraph 2, the sentence here</p> <p>11 says, "I do not provide conclusions about</p> <p>12 whether Google's conduct is not</p> <p>13 anticompetitive." But the way I think about</p> <p>14 this is this is the premise of the market</p> <p>15 design exercise. So if we had completely</p> <p>16 competitive markets, as I teach my</p> <p>17 undergraduates, we would say, Well, is there a</p> <p>18 case for market design here? If markets were</p> <p>19 functioning as the ideal that we aspire to,</p> <p>20 the principles that I outline in my report,</p> <p>21 then what is the case for the designer?</p> <p>22 So my assignment was not to give these</p> <p>23 conclusions about whether Google's conduct is</p> <p>24 anticompetitive, but that's kind of the</p>              | <p style="text-align: right;">Page 88</p> <p>1 your market design principles?</p> <p>2 MR. CHANG: Objection. Form.</p> <p>3 A. What I'm -- I mean, I -- could you ask</p> <p>4 the question one more time. I want to make</p> <p>5 sure I understand the language precisely.</p> <p>6 BY MR. RYBNICEK:</p> <p>7 Q. Are you opining that Google's conduct</p> <p>8 is anticompetitive because it doesn't follow</p> <p>9 the market design principles you articulate in</p> <p>10 your report?</p> <p>11 MR. CHANG: Same objection.</p> <p>12 Form.</p> <p>13 A. My report is opining that Google has</p> <p>14 this strong conflict of incentives that</p> <p>15 motivates many of the conducts that have led</p> <p>16 to adverse effects on competition in the</p> <p>17 markets here.</p> <p>18 BY MR. RYBNICEK:</p> <p>19 Q. Is it your opinion that Google's</p> <p>20 conduct is anticompetitive because they don't</p> <p>21 follow the design -- market design principles</p> <p>22 you articulate in your report?</p> <p>23 MR. CHANG: Objection. Form.</p> <p>24 A. My task here was to apply the market</p>                                                                                                                                                         |
| <p style="text-align: right;">Page 87</p> <p>1 building block of my study of the incentives</p> <p>2 motivating Google's conduct.</p> <p>3 Q. And is it fair to say that your</p> <p>4 assignment was also not to conclude whether or</p> <p>5 not Google has monopoly power?</p> <p>6 MR. CHANG: Objection. Form.</p> <p>7 A. My assignment is stated in this</p> <p>8 paragraph, but I give you the same answer I</p> <p>9 just gave a second ago, that the starting</p> <p>10 point of a market design analysis is to ask is</p> <p>11 the market functioning according to this</p> <p>12 competitive ideal? And in the course of my</p> <p>13 analysis, I, of course, looked at whether the</p> <p>14 participants in this market have market power</p> <p>15 and whether some of the conducts are</p> <p>16 anticompetitive. But, you know, my report is</p> <p>17 not providing, as I say here, conclusions on</p> <p>18 those two topics, but it's part of my</p> <p>19 analysis.</p> <p>20 BY MR. RYBNICEK:</p> <p>21 Q. So is it fair to say you're opining on</p> <p>22 whether Google's conduct is -- strike that.</p> <p>23 Are you opining that Google's conduct</p> <p>24 is anticompetitive because it does not follow</p> | <p style="text-align: right;">Page 89</p> <p>1 design principles to look at Google's</p> <p>2 incentives and why would Google have an</p> <p>3 incentive to restrict publisher choice if it's</p> <p>4 representing the interests of publishers. I</p> <p>5 would have thought that Google would want to</p> <p>6 expand choice and do what's in the best</p> <p>7 interest for publishers.</p> <p>8 So they were not able to -- they were</p> <p>9 able to get away with -- they were able to</p> <p>10 take actions, as I describe in my report, that</p> <p>11 are against publisher interest because they</p> <p>12 had market power. And as my report describes,</p> <p>13 the effects of those restrictions of choice</p> <p>14 were to obstruct the outcomes from being</p> <p>15 competitive.</p> <p>16 Q. Okay. But you, sitting here today,</p> <p>17 you can't point to a place in your report</p> <p>18 where you say Google has market power or</p> <p>19 monopoly power; is that fair?</p> <p>20 A. So my section headings here are about</p> <p>21 Google's harm to competition, Google's taking</p> <p>22 away of choice, Google's control of various</p> <p>23 parts of the markets here. I also discuss</p> <p>24 Google's contractual tie in my report.</p> |

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| <p style="text-align: right;">Page 90</p> <p>1 So if you're asking me about a</p> <p>2 specific sentence, I cannot say off the top of</p> <p>3 my head whether that sentence exists without</p> <p>4 going through my entire report, and we</p> <p>5 probably don't want to use our time to do</p> <p>6 that. But each of these sections that I just</p> <p>7 described speak very clearly to these issues</p> <p>8 of market power and anticompetitive conduct.</p> <p>9 Q. All right. Appendix A of your report,</p> <p>10 I think, has your CV.</p> <p>11 Have you found that?</p> <p>12 A. I found it, yes.</p> <p>13 Q. Great.</p> <p>14 Can you provide us an overview of your</p> <p>15 educational background for the record.</p> <p>16 A. Sure. I did my undergraduate degree</p> <p>17 at Harvard University, where I studied applied</p> <p>18 mathematics with a minor in economics. I also</p> <p>19 got a master's degree in applied mathematics</p> <p>20 the same year. I stayed on to do a Ph.D. in</p> <p>21 business economics, and I graduated in 2007.</p> <p>22 And my main Ph.D. advisor was Professor Alvin</p> <p>23 Roth. So that's my education line there.</p> <p>24 Q. And what is business economics?</p> | <p style="text-align: right;">Page 92</p> <p>1 A. That's correct, yes.</p> <p>2 Q. Your specialty is market design; is</p> <p>3 that fair?</p> <p>4 A. That's correct, yes.</p> <p>5 Q. And your mentor, Alvin Roth,</p> <p>6 characterized market design as economic</p> <p>7 engineering. I think that's what you've</p> <p>8 quoted in your report. Is that accurate?</p> <p>9 A. Yeah, I believe Professor Roth has</p> <p>10 described it that way. He has a famous</p> <p>11 article from 2002 that's called "The Economist</p> <p>12 as Engineer," and he wrote that article the</p> <p>13 year I took his class actually, so that's the</p> <p>14 lens that he's put on the field.</p> <p>15 Q. Do you agree that's an apt</p> <p>16 characterization?</p> <p>17 A. "The Economist as Engineer" I think</p> <p>18 is, at a high level, a nice way of describing</p> <p>19 market design. So, yeah, I agree with that.</p> <p>20 I've heard other people describe it, you know,</p> <p>21 less nicely as "The economist as plumber." So</p> <p>22 I think that might be more appropriate in some</p> <p>23 circumstances than "engineer."</p> <p>24 Q. And so you're an economic engineer or</p>                                                              |
| <p style="text-align: right;">Page 91</p> <p>1 A. Business economics is an economics</p> <p>2 degree that is offered jointly between the</p> <p>3 faculty of arts and sciences at Harvard and</p> <p>4 Harvard Business School. So one way to think</p> <p>5 about this program is it's an economics Ph.D.,</p> <p>6 so we had to take the entire requirements for</p> <p>7 economics Ph.D.s, and we also had to take</p> <p>8 several additional courses taught at Harvard</p> <p>9 Business School.</p> <p>10 And our advisor -- one of our advisors</p> <p>11 had to be joint between -- had to have an</p> <p>12 affiliation with Harvard Business School. So</p> <p>13 Alvin Roth, who is my main Ph.D. advisor,</p> <p>14 fulfilled that role.</p> <p>15 Q. Got it.</p> <p>16 You spent a lot of time in Boston, it</p> <p>17 appears.</p> <p>18 A. I have spent a majority of my life</p> <p>19 here now, yes.</p> <p>20 Q. You don't have a degree in marketing,</p> <p>21 though, right?</p> <p>22 A. I do not have a degree in marketing.</p> <p>23 Q. And you don't have a degree in</p> <p>24 advertising, correct?</p>                                                                                                     | <p style="text-align: right;">Page 93</p> <p>1 an economic plumber, depending on how you</p> <p>2 think about it?</p> <p>3 A. That is, I think, the guiding</p> <p>4 principles of market design economics, yeah.</p> <p>5 That manifesto that Roth wrote in</p> <p>6 2002, I think, has guided a lot of the folks</p> <p>7 who work in this area. So, for instance, I</p> <p>8 founded the National Bureau of Economic</p> <p>9 Research's working group on market design. So</p> <p>10 that's a professional meeting of about 50 or</p> <p>11 so scholars who work on market design. We're</p> <p>12 going to meet this Friday at Stanford.</p> <p>13 And if you look at the mission</p> <p>14 statement of that group -- I believe I cite</p> <p>15 that in my report -- we focus on particular</p> <p>16 market-clearing institutions across a variety</p> <p>17 of domains and engineer them, ask whether</p> <p>18 they're working well and how maybe they can be</p> <p>19 engineered to work better.</p> <p>20 Q. What's an example of a recent example</p> <p>21 of where the group did that?</p> <p>22 A. So it's the -- it's members of the</p> <p>23 group who work on these issues. But one</p> <p>24 example that I've spent a lot of time working</p> |

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| <p style="text-align: right;">Page 94</p> <p>1 on is the way that graduates of U.S. military<br/>2 academy, which is sometimes called West Point<br/>3 and the ROTC program, the Reserve Officer<br/>4 Training Corps program, fulfill their active<br/>5 duty service obligation.<br/>6 So that's an example of a matching<br/>7 market where, as a cadet who is graduating<br/>8 from West Point, at the conclusion of your<br/>9 four years, you have to go through branch<br/>10 assignment. Essentially, you get to go to<br/>11 college at a highly subsidized rate in<br/>12 exchange for committing to serve in the<br/>13 military for a certain number of years. So<br/>14 that's called the ADSO requirement, A-D-S-O.<br/>15 And cadets are asked to submit a<br/>16 ranking of branches that they're interested<br/>17 in, like artillery or cyber or quartermaster.<br/>18 And the military has criteria that they use to<br/>19 rate cadets, what's called the order of merit<br/>20 list. So that includes your grades at West<br/>21 Point, as well as your leadership<br/>22 capabilities, as well as your physical<br/>23 fitness. And then they run a centralized<br/>24 market-clearing procedure to assign cadets to</p> | <p style="text-align: right;">Page 96</p> <p>1 Ph.D. students take at MIT, students who are<br/>2 getting a Ph.D. in economics, in information<br/>3 technology, in data science and finance on<br/>4 microeconomic theory. So that's one class.<br/>5 The other class is an undergraduate<br/>6 elective course on market design. That's a<br/>7 class that's taught in the economics<br/>8 department, but it also counts for credit for<br/>9 students who major in Course 6, which is MIT<br/>10 lingo for computer science.<br/>11 So we have a tradition at MIT of<br/>12 labeling our courses only in terms of numbers.<br/>13 So we have a joint degree program that's<br/>14 called 614, so 6 is computer science; 14 is<br/>15 economics. And the market design class is a<br/>16 kind of capstone class for students interested<br/>17 in economics and computer science issues, so<br/>18 I'm currently teaching that class as well.<br/>19 Q. And does the economics program have<br/>20 kind of specialties, like finance and others?<br/>21 A. Yes. The economics program -- let me<br/>22 take that question at several levels.<br/>23 So when you do your Ph.D., our<br/>24 Ph.D. students specialize in certain</p> |
| <p style="text-align: right;">Page 95</p> <p>1 their first positions. So that's something<br/>2 I've worked on and written about. So that --<br/>3 that's one example, yeah.<br/>4 BY MR. RYBNICEK:<br/>5 Q. But your main profession is teaching;<br/>6 is that right?<br/>7 A. It's a good question. I'm a<br/>8 professor, and as part of my requirements as a<br/>9 professor, I teach classes. I supervise<br/>10 doctoral dissertations, and I conduct<br/>11 research, and I also run a research lab at MIT<br/>12 called Blueprint Labs. That's a research lab<br/>13 that's focused on market design applications<br/>14 to public policy.<br/>15 Q. Do you only teach in the economics<br/>16 department?<br/>17 A. Currently, I teach in the economics<br/>18 department undergraduates and graduate<br/>19 students. I have had the opportunity to teach<br/>20 in business schools in the past.<br/>21 Q. And what types of classes are you<br/>22 currently teaching?<br/>23 A. This fall, I'm teaching two classes.<br/>24 One is the very first course that</p>                                                                                                                                                                | <p style="text-align: right;">Page 97</p> <p>1 subfields, like finance or market design or<br/>2 behavioral economics. The undergraduate<br/>3 courses that we offer reflect many of those<br/>4 topics as well. So there's specialization<br/>5 that way.<br/>6 You don't get a degree, though, that<br/>7 says, I have a Ph.D. in economics with a focus<br/>8 on market design, with the one exception of --<br/>9 well, maybe there's a few exceptions. Finance<br/>10 Ph.D.s are a distinct Ph.D. Information<br/>11 technology is a distinct Ph.D. And the --<br/>12 Institute for Data and Social Sciences have<br/>13 their own distinct Ph.D.<br/>14 Q. Does market design kind of fall into<br/>15 its own bucket or focus, or does it fall under<br/>16 a broader heading?<br/>17 A. Market design is, I think -- I mean --<br/>18 let me pause for a second.<br/>19 So I guess the answer to that is yes<br/>20 to both. So we have a minor in market design,<br/>21 so we have students who list market design as<br/>22 their primary area of interest. So this fall,<br/>23 I have a Ph.D. student who is looking for a<br/>24 job, and his primary field of interest is</p>                                           |

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| <p style="text-align: right;">Page 98</p> <p>1 market design. But market design is a</p> <p>2 cross-cutting field. It's a field that</p> <p>3 overlaps with other areas of economics.</p> <p>4 So the example I gave you a second ago</p> <p>5 about the military job placement, you could</p> <p>6 say it sounds more like a labor economics</p> <p>7 topic. The lectures that I teach on auction</p> <p>8 markets are maybe more closely related to</p> <p>9 topics in industrial orGansization. So that's</p> <p>10 one of the nice things about the field of</p> <p>11 market design. I think why Roth describes it</p> <p>12 as an engineering field, it's really a</p> <p>13 solutions-oriented discipline. It's very</p> <p>14 applied.</p> <p>15 So the market designer comes to a</p> <p>16 problem with the entire toolbox of economics,</p> <p>17 theoretical work, empirical work, experimental</p> <p>18 work. Sometimes they conduct their own lab</p> <p>19 experiments even. And the aspiration is to</p> <p>20 try to improve the functioning of specific</p> <p>21 markets. So there's a range of different</p> <p>22 areas that we cross.</p> <p>23 Q. That's not -- obviously not a</p> <p>24 mechanical engineering or a chemical -- it's</p> | <p style="text-align: right;">Page 100</p> <p>1 have not.</p> <p>2 Q. And I assume none of your</p> <p>3 Ph.D. students -- well, strike that.</p> <p>4 Your CV also lists that you -- or that</p> <p>5 you were a weekly visitor at something called</p> <p>6 the Microsoft Research New England?</p> <p>7 A. That's correct, yes.</p> <p>8 Q. From 2015 to 2016?</p> <p>9 A. (Witness nodding.)</p> <p>10 Q. What is -- what is Microsoft Research</p> <p>11 New England?</p> <p>12 A. Microsoft Research New England is a</p> <p>13 research laboratory that's two buildings down</p> <p>14 from our economics department that hosts</p> <p>15 academic visitors, and they do basic research</p> <p>16 on a range of topics.</p> <p>17 Q. Is it affiliated with MIT?</p> <p>18 A. No, it's not.</p> <p>19 Q. And is it, as the name suggests,</p> <p>20 affiliated with Microsoft?</p> <p>21 A. It is, yes.</p> <p>22 Q. And so did you receive any</p> <p>23 compensation from Microsoft for that</p> <p>24 position?</p>                                                                                                                                                                                                                                         |
| <p style="text-align: right;">Page 99</p> <p>1 like a social engineering field, right?</p> <p>2 A. I don't know about the word "social</p> <p>3 engineering." I think that word has a lot of</p> <p>4 connotations that may not be positive</p> <p>5 connotations.</p> <p>6 Another description, if you don't like</p> <p>7 the economist as engineering description, is</p> <p>8 what the economists call the field of market</p> <p>9 design, which is a theory of an intelligently</p> <p>10 designed invisible hand.</p> <p>11 So one thing that we're trying to do</p> <p>12 is -- in market design economics is harness</p> <p>13 the forces of competition. But realizing that</p> <p>14 the rules of the game are designed by folks,</p> <p>15 you know, either inside the system or outside</p> <p>16 of the system, and we want to ensure that</p> <p>17 those rules are designed in a way that leads</p> <p>18 to beneficial outcomes for participants.</p> <p>19 Q. Have you ever taught a class in</p> <p>20 antitrust economics?</p> <p>21 A. Years ago -- I'm sorry. A lecture or</p> <p>22 a class?</p> <p>23 Q. A class. A course.</p> <p>24 A. A course in antitrust economics, no, I</p>                                                        | <p style="text-align: right;">Page 101</p> <p>1 A. I believe I did. I don't know the</p> <p>2 exact details of it.</p> <p>3 Q. Do you recall what you researched</p> <p>4 while you were in this position?</p> <p>5 A. Yes. So I was a weekly visitor. They</p> <p>6 have a weekly visitor program. And to the</p> <p>7 best of my recollection, there was a seminar</p> <p>8 there once a week, and they have a group</p> <p>9 that's interested in economics in computer</p> <p>10 science. So I was working on topics on</p> <p>11 matching markets. I was doing that the same</p> <p>12 year I was a visiting professor at Harvard</p> <p>13 University.</p> <p>14 So if memory serves, on Fridays, maybe</p> <p>15 every week or every other week, I would go to</p> <p>16 Microsoft Research for the seminar. And I</p> <p>17 think I also spoke in the seminar. So that</p> <p>18 environment involves a mix of academics or</p> <p>19 folks who have one foot in academia and one</p> <p>20 foot in industry talking about basic research.</p> <p>21 So my research has always, you know,</p> <p>22 in -- that time period was 2015. Probably</p> <p>23 what I was working on at that point was</p> <p>24 matching systems for public school children to</p> |



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| <p style="text-align: right;">Page 102</p> <p>1 get into different high schools in big cities.<br/> 2 Actually, that's exactly what I talked about.<br/> 3 I remember it now.<br/> 4 So I gave a research seminar in that<br/> 5 workshop that was specifically about how you<br/> 6 can use the fact that there's rationing of<br/> 7 school seats to measure what is the<br/> 8 consequence of getting assigned one of your<br/> 9 choices.<br/> 10 Q. Have you done any other work for<br/> 11 Microsoft?<br/> 12 A. I have not.<br/> 13 Q. Have you done any work for any firm in<br/> 14 the ad tech sector?<br/> 15 A. I have not.<br/> 16 Q. We talked about that you don't have a<br/> 17 degree in marketing or advertising, but have<br/> 18 you ever done any work in marketing or<br/> 19 advertising?<br/> 20 A. I have not, no.<br/> 21 Q. So you don't have any experience with<br/> 22 advertising or marketing?<br/> 23 MR. CHANG: Objection. Form.<br/> 24 A. Personal experience --</p>                                                                                                                                             | <p style="text-align: right;">Page 104</p> <p>1 of individuals.<br/> 2 I have my expertise in market design,<br/> 3 and I've applied that lens to a study of the<br/> 4 record. And, you know, part of what I'm able<br/> 5 to review that certain industry participants<br/> 6 are not able to see are information between<br/> 7 participants in this market that were not made<br/> 8 public to some of the participants. So there<br/> 9 are certainly aspects of this industry that<br/> 10 I'm aware of and I've had the opportunity to<br/> 11 study that many industry participants have<br/> 12 not.<br/> 13 BY MR. RYBNICEK:<br/> 14 Q. Have you ever talked to anybody who is<br/> 15 in the ad tech business?<br/> 16 A. In preparation for -- of this report<br/> 17 or in general?<br/> 18 I did not -- I didn't feel the need to<br/> 19 in preparing this report because I had access<br/> 20 to a tremendous amount of information, and my<br/> 21 report is talking, you know, to specific<br/> 22 conducts at specific points in time. And the<br/> 23 information that I had access to is<br/> 24 information that's coming, you know, from</p>                                        |
| <p style="text-align: right;">Page 103</p> <p>1 BY MR. RYBNICEK:<br/> 2 Q. Correct.<br/> 3 A. -- in terms of working in a firm that<br/> 4 is selling ads or buying ads? No, I have not.<br/> 5 Q. And do you have any experience with<br/> 6 digital advertising specifically?<br/> 7 A. As a participant in those markets, I<br/> 8 have not bought or sold digital ads. But if<br/> 9 your question is about knowledge of this<br/> 10 market, I've spent a lot of time reviewing<br/> 11 and -- reviewing documents about this market<br/> 12 in the record.<br/> 13 I also teach a class in my<br/> 14 undergraduate class -- in fact, this was about<br/> 15 two weeks ago -- about advertising and the<br/> 16 pricing of advertising, specific auction<br/> 17 mechanisms in my undergraduate class.<br/> 18 Q. Would you consider yourself -- would<br/> 19 you consider yourself an expert in ad tech?<br/> 20 A. If by "expert" you mean someone who<br/> 21 knows more than the average person, yes.<br/> 22 Q. More than industry participants?<br/> 23 MR. CHANG: Objection. Form.<br/> 24 A. Industry participants is a large group</p> | <p style="text-align: right;">Page 105</p> <p>1 testimony and depositions, so that has a lot<br/> 2 of advantages over just talking to someone<br/> 3 because those depositions take place under<br/> 4 oath and, you know, people are truthful.<br/> 5 Q. We talked about this. You haven't<br/> 6 taught an antitrust economics course, and, of<br/> 7 course, you hold yourself out as an expert in<br/> 8 market design.<br/> 9 But do you also hold yourself out at<br/> 10 an expert in antitrust economics?<br/> 11 A. If by "expert" you mean someone who<br/> 12 knows more than the average person, certainly.<br/> 13 Q. Do you have -- do you know more than<br/> 14 someone who teaches antitrust economics for a<br/> 15 living?<br/> 16 A. Again, there's a wide range of folks<br/> 17 who teach antitrust economics for a living.<br/> 18 I'll tell you that my very first job<br/> 19 out of college, after I finished my applied<br/> 20 mathematics degree, was as an intern at the<br/> 21 Economic Analysis Group of the Department of<br/> 22 Justice, so in 2002. So I have studied and<br/> 23 paid attention to issues of competition policy<br/> 24 for more than 20 years.</p> |

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| <p style="text-align: right;">Page 106</p> <p>1 So while I have not taught a specific</p> <p>2 course -- in fact, at MIT, we don't have the</p> <p>3 bandwidth to teach an economics course solely</p> <p>4 on antitrust economics. There are</p> <p>5 undergraduate courses on industrial</p> <p>6 organization and regulation which touch upon</p> <p>7 those issues. I have a lot of knowledge about</p> <p>8 this area, I believe.</p> <p>9 Q. Have you ever been retained to provide</p> <p>10 your opinion on -- related to antitrust</p> <p>11 economics?</p> <p>12 MR. CHANG: I'm going to</p> <p>13 instruct the witness to respond to that</p> <p>14 question to the extent he can -- to the extent</p> <p>15 that he has been disclosed as a testifying</p> <p>16 expert. I don't want to run afoul of anything</p> <p>17 else that's going on right now.</p> <p>18 Is that fair?</p> <p>19 MR. RYBNICEK: I don't</p> <p>20 understand the issue.</p> <p>21 MR. CHANG: If he is working for</p> <p>22 some other entity and has not been --</p> <p>23 MR. RYBNICEK: I don't need to</p> <p>24 know the entity. I'm just asking if he's been</p> | <p style="text-align: right;">Page 108</p> <p>1 that case?</p> <p>2 A. I can tell you at a high level. I</p> <p>3 don't want to violate any protective rules</p> <p>4 that I've signed.</p> <p>5 Q. No, nor am I asking you to.</p> <p>6 A. Okay. That was a case about market</p> <p>7 design issues in the securities lending</p> <p>8 market.</p> <p>9 Q. Okay. And did you provide an opinion</p> <p>10 on damages or the merits?</p> <p>11 A. I did both.</p> <p>12 Q. And do you know if there was ever an</p> <p>13 attempt to exclude your testimony -- excuse</p> <p>14 me -- exclude your report?</p> <p>15 A. In that matter, I do not believe there</p> <p>16 was.</p> <p>17 Q. Okay. So in your report -- in</p> <p>18 Paragraph 35 in your opening report, you talk</p> <p>19 about your experience working in market</p> <p>20 design, and you provide three examples, one of</p> <p>21 which I think we've already discussed.</p> <p>22 Do you see that?</p> <p>23 A. So could you repeat the paragraph</p> <p>24 number.</p>                                                                                                                      |
| <p style="text-align: right;">Page 107</p> <p>1 retained. It could be on an anonymous basis.</p> <p>2 I'm just asking if he's been retained in the</p> <p>3 capacity of providing his expertise on</p> <p>4 antitrust economics.</p> <p>5 MR. CHANG: You can respond to</p> <p>6 the extent you've been retained as a</p> <p>7 testifying expert.</p> <p>8 A. The answer is yes. I think we have an</p> <p>9 example in the report of a deposition that</p> <p>10 I've submitted in a prior matter.</p> <p>11 BY MR. RYBNICEK:</p> <p>12 Q. This is the Iowa --</p> <p>13 A. Yes, that's right, the Iowa pension</p> <p>14 fund case.</p> <p>15 Q. And you submitted a report or you</p> <p>16 served -- sorry.</p> <p>17 You submitted a report in that</p> <p>18 matter?</p> <p>19 A. That is correct.</p> <p>20 Q. And did you testify at trial?</p> <p>21 A. That case did not go to trial.</p> <p>22 Q. Were you deposed?</p> <p>23 A. Yes.</p> <p>24 Q. And what -- what were the issues in</p>                                                                                                                                                      | <p style="text-align: right;">Page 109</p> <p>1 Q. 35.</p> <p>2 A. 35. Okay. Uh-huh. Let me just read</p> <p>3 this. Sorry.</p> <p>4 (Witness reviews document.)</p> <p>5 Great. Yes. Okay. Yes.</p> <p>6 Q. And so what are the three markets or</p> <p>7 areas in which you've worked on -- worked with</p> <p>8 respect to market design?</p> <p>9 MR. CHANG: Objection. Form.</p> <p>10 A. The paragraph describes work I've done</p> <p>11 studying centralized mechanisms for assigning</p> <p>12 students to schools. So I've done a lot of</p> <p>13 work on that topic and have been involved in</p> <p>14 practical designs across a number of American</p> <p>15 cities. And I have written many research</p> <p>16 papers about various aspects of that system</p> <p>17 and systems like that.</p> <p>18 The second example are cadets to</p> <p>19 military posts. So that's what we've talked</p> <p>20 about with the West Point and ROTC example.</p> <p>21 So that's another place where I've been</p> <p>22 actively involved in the design. The West</p> <p>23 Point uses a system that myself and my</p> <p>24 colleague Sonmez proposed.</p> |



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| <p style="text-align: right;">Page 110</p> <p>1 And then the last example here is</p> <p>2 research that I've taken studying the process</p> <p>3 by which medical residents get assigned their</p> <p>4 first internship. That's called the National</p> <p>5 Residency Matching Program. I have not been</p> <p>6 involved directly in the design of that</p> <p>7 system, but I have researched aspects of the</p> <p>8 algorithm that's used in that system.</p> <p>9 BY MR. RYBNICEK:</p> <p>10 Q. And in that -- in Paragraph 35, you</p> <p>11 say, "I've spent most of my career researching</p> <p>12 and designing matching marketplaces to produce</p> <p>13 efficient and other desirable outcomes."</p> <p>14 What do you mean when you say</p> <p>15 "marketplace" in that context?</p> <p>16 A. What I mean by a matching marketplace</p> <p>17 is that there are two sides. So in the</p> <p>18 example of students in schools, there's the</p> <p>19 side of students, and there's the side of</p> <p>20 schools. And this is a setting where there's</p> <p>21 no price, so we have to clear the market</p> <p>22 without the usual instruments that we have in</p> <p>23 economics of, you know, setting demand equal</p> <p>24 to supply using the price. So that's a</p> | <p style="text-align: right;">Page 112</p> <p>1 practical. And the same consideration applies</p> <p>2 to the cadet branch assignment setting.</p> <p>3 And so the medical resident matching</p> <p>4 program is another real-life institution that</p> <p>5 you might have had a friend get their first</p> <p>6 residency position through this kind of</p> <p>7 system. So these are just really salient</p> <p>8 examples.</p> <p>9 The rest of the paragraph, I should</p> <p>10 mention, talks about methodological work I've</p> <p>11 also done. And so together with Sonmez, one</p> <p>12 of the things that we've studied is ways to</p> <p>13 measure the extent to which different</p> <p>14 mechanisms encourage straightforward behavior</p> <p>15 by participants. And so that is a paper that</p> <p>16 actually spans several other applications of</p> <p>17 market design reasoning, including matching</p> <p>18 markets as well as auction markets.</p> <p>19 Q. You said you spent most of your time</p> <p>20 working on student assignments in schools. Is</p> <p>21 it fair to say more than half of your papers</p> <p>22 are on that topic probably?</p> <p>23 A. I could take a look at that. I don't</p> <p>24 know. Is it half? Roughly. I'll accept</p> |
| <p style="text-align: right;">Page 111</p> <p>1 marketplace.</p> <p>2 The other two examples, cadets to</p> <p>3 military posts also have that property that</p> <p>4 there is -- there are cadets, and then there</p> <p>5 are jobs. So you can think of that as there's</p> <p>6 the demand, and then there's the supply, and</p> <p>7 the marketplace is a way to clear that market</p> <p>8 to match up the demand and the supply.</p> <p>9 The medical residents example also</p> <p>10 fits into that category.</p> <p>11 Q. And so are these the three areas that</p> <p>12 you've -- why do you point -- highlight these</p> <p>13 three areas? These are the three areas that</p> <p>14 you've most been involved in?</p> <p>15 A. The area I've been most involved in is</p> <p>16 the student-to-school matching problem.</p> <p>17 That's something I've been working on since my</p> <p>18 Ph.D. days, so I've studied this issue for 20</p> <p>19 years, many different aspects of this issue.</p> <p>20 The reason I mention that example is</p> <p>21 not only that I've worked on this for so long,</p> <p>22 but it's a real-life example of institutions</p> <p>23 that I have helped to design. So it's not</p> <p>24 only theoretical, but it's also very</p>            | <p style="text-align: right;">Page 113</p> <p>1 that.</p> <p>2 Q. Roughly?</p> <p>3 A. Yeah.</p> <p>4 Q. Is this for public schools?</p> <p>5 A. The -- yeah, the settings I focused on</p> <p>6 are public schools in big cities.</p> <p>7 Q. Washington, D.C.?</p> <p>8 A. Washington, D.C., in 2012. There's a</p> <p>9 program there that was called My School DC</p> <p>10 that involves children in Washington trying to</p> <p>11 get into public schools in Washington, and</p> <p>12 they used a centralized clearinghouse that I</p> <p>13 was fortunate to be part of the design team</p> <p>14 for that project.</p> <p>15 Q. And so when -- taking Washington,</p> <p>16 D.C., as an example, when a family is seeking</p> <p>17 to get an assignment for a school, do they</p> <p>18 have an alternative besides the system that</p> <p>19 the school system has set up?</p> <p>20 A. The family -- it's a public school, so</p> <p>21 an alternative is always to not go to public</p> <p>22 school.</p> <p>23 Q. Do most people have that</p> <p>24 alternative?</p>                                                                                                                                                                                                    |

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| <p style="text-align: right;">Page 114</p> <p>1 A. I haven't studied that very closely,<br/> 2 but my impression is that not going to public<br/> 3 school involves paying tuition that many<br/> 4 families cannot do.<br/> 5 Q. But if you want to participate in<br/> 6 public school in D.C., you have to use this<br/> 7 matching system that the D.C. school system<br/> 8 has; is that right?<br/> 9 A. You know, so I was heavily involved in<br/> 10 that system back in 2012. And sadly,<br/> 11 Washington, D.C., is one of the sites that no<br/> 12 longer returns my phone calls. So I could<br/> 13 speak to the system back in 2012. I don't<br/> 14 know what the current rules are right now.<br/> 15 So the systems are often used for the<br/> 16 primary entry point of schools, kindergarten,<br/> 17 middle school, sixth grade, high school, ninth<br/> 18 grade. So if I am joining school in the<br/> 19 middle of a year or if I'm joining school in a<br/> 20 nontransition grade, like third grade, there's<br/> 21 other ways to access schools.<br/> 22 Q. But there are multiple auctions or<br/> 23 multiple marketplaces; is that fair?<br/> 24 A. Yeah, I think that takes place through</p> | <p style="text-align: right;">Page 116</p> <p>1 public goods provision, like other settings<br/> 2 where we have, you know, firefighters or<br/> 3 police that are provided by local governments,<br/> 4 there is the option to move. So Tiebout's<br/> 5 main idea was competitive pressure can exist<br/> 6 in these kinds of setting by -- people call it<br/> 7 voting with your feet.<br/> 8 So if the D.C. system is really<br/> 9 functioning poorly, then they might lose<br/> 10 enrollment. And I haven't look at D.C., I<br/> 11 mentioned, in a long time, but in many big<br/> 12 city school districts, they are experiencing<br/> 13 very substantial declines in enrollment of<br/> 14 students. And so that is going to create<br/> 15 pressure on the district to try to do things<br/> 16 to retain enrollment, like, for instance,<br/> 17 offering pre-K. So that's a competitive<br/> 18 response that's coming from the threat of<br/> 19 exit.<br/> 20 Q. But I guess, going back to my original<br/> 21 question, there's no other marketplace that<br/> 22 you could turn to for -- to attend D.C.<br/> 23 schools, public schools?<br/> 24 MR. CHANG: Objection. Form.</p>   |
| <p style="text-align: right;">Page 115</p> <p>1 the district policy. What -- how you get<br/> 2 assigned a school is a prerogative of the<br/> 3 district. So they are the sole designer or<br/> 4 orGansizer of that market.<br/> 5 Q. They're like a monopolist?<br/> 6 A. I mean, it's a tricky word to use in<br/> 7 this context because it's a public good. So<br/> 8 we usually think of education in economics as<br/> 9 a public good. And so why are schools<br/> 10 publicly provided? Because of a number of<br/> 11 reasons, but I wouldn't use the word<br/> 12 "monopolist" there.<br/> 13 Q. You don't disagree that it's the only<br/> 14 option?<br/> 15 A. Unless you want to, you know, either<br/> 16 move to another city or send your kid to<br/> 17 private school if you live in Washington, D.C.<br/> 18 Q. So there's not competition for<br/> 19 improving the marketplace; is that fair to<br/> 20 say?<br/> 21 A. Well, in economics, we talk about<br/> 22 competition through what's called Tiebout.<br/> 23 Charles Tiebout was a contemporary of Milton<br/> 24 Friedman, and his idea was, even in local</p>                                                                                 | <p style="text-align: right;">Page 117</p> <p>1 A. To attend D.C. public schools, so<br/> 2 that's ruling out leaving D.C. or going to a<br/> 3 private school, you're saying. So if I want<br/> 4 to access a D.C. public school, I have to go<br/> 5 through Washington, D.C., public schools<br/> 6 registration process, yes.<br/> 7 BY MR. RYBNICEK:<br/> 8 Q. And do you -- sorry. Not "do you."<br/> 9 Do families pay a price to participate<br/> 10 in these markets -- marketplaces, at least at<br/> 11 the time when you were involved in it?<br/> 12 A. There's several dimensions of the word<br/> 13 "pay a price," so let's take those in turn.<br/> 14 The first is to register and submit a<br/> 15 list of school choices in Washington, D.C.<br/> 16 It's my understanding that this is true today,<br/> 17 but certainly back when I was involved, you<br/> 18 just simply sign up and get an account, and<br/> 19 it's free.<br/> 20 There's an obligation in most<br/> 21 cities -- again, I don't know the details of<br/> 22 Washington, D.C. -- that if you are school<br/> 23 age, the City has to provide you a seat at<br/> 24 school. So that's kind of the immediate</p> |

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| <p style="text-align: right;">Page 118</p> <p>1 question of signing up to participate in the</p> <p>2 market.</p> <p>3 But there's a second dimension of your</p> <p>4 question, which could be the decision to live</p> <p>5 in Washington, D.C., and so in the background</p> <p>6 you are transacting, you're paying a price via</p> <p>7 rental markets or through housing markets to</p> <p>8 reside in Washington, D.C. So there are parts</p> <p>9 of Washington, D.C., that are not affordable</p> <p>10 for many families, so they're priced out of</p> <p>11 those areas.</p> <p>12 And the way the Washington, D.C.,</p> <p>13 system used to work, certain areas of</p> <p>14 Washington, D.C., would give heightened</p> <p>15 priority to families from certain residences.</p> <p>16 So implicitly -- this is a second layer of</p> <p>17 your question -- there is a price that's</p> <p>18 happening through the housing market.</p> <p>19 Q. But there's no price that affects the</p> <p>20 supply and demand; is that fair?</p> <p>21 MR. CHANG: Objection. Form.</p> <p>22 A. I don't know if I agree with that.</p> <p>23 BY MR. RYBNICEK:</p> <p>24 Q. Okay. In what way do you disagree?</p>                                                         | <p style="text-align: right;">Page 120</p> <p>1 Q. Maybe I wasn't being clear. I guess</p> <p>2 I'm talking about the price for the tool, the</p> <p>3 marketplace, right? So --</p> <p>4 A. Okay.</p> <p>5 Q. -- not the price of the ultimate good</p> <p>6 that you're seeking.</p> <p>7 A. Uh-huh. Yeah. So as I said, if you</p> <p>8 want to access the tool, every resident of</p> <p>9 Washington, D.C., has -- I think this is true</p> <p>10 today as well as back in 2012 -- the</p> <p>11 opportunity to use a tool without paying any</p> <p>12 price.</p> <p>13 Q. Right.</p> <p>14 A. Yeah.</p> <p>15 Q. There's a hundred thousand more people</p> <p>16 that come in. They're not going to charge you</p> <p>17 more, right? As the supply comes up or --</p> <p>18 excuse me -- as the demand goes up, price</p> <p>19 isn't going to go up, right?</p> <p>20 A. To create an account on My Schools</p> <p>21 DC --</p> <p>22 Q. Yes.</p> <p>23 A. -- they would be unlikely to do that,</p> <p>24 I think.</p>                                                                                                                                                                                                       |
| <p style="text-align: right;">Page 119</p> <p>1 A. If we look at a district in</p> <p>2 Washington, D.C., Dupont Circle, that has</p> <p>3 schools that are sought after, and if the D.C.</p> <p>4 system still has what folks call neighborhood</p> <p>5 priority, what that amounts to is if I'm an</p> <p>6 applicant from the neighborhood, I get</p> <p>7 heightened priority for a slot in Dupont</p> <p>8 Circle.</p> <p>9 So what dictates the value of that</p> <p>10 priority in the system -- well, the amount of</p> <p>11 residents who live in Dupont Circle and if --</p> <p>12 how are they rationed? Why doesn't everyone</p> <p>13 get access to that priority? Well, they're</p> <p>14 being rationed through the housing market, the</p> <p>15 price of rents and price of real estate there.</p> <p>16 So there is that -- you could call it an</p> <p>17 implicit price, but, you know, there's a</p> <p>18 shortage.</p> <p>19 In this hypothetical example, I'm just</p> <p>20 assuming the schools in Dupont Circle are</p> <p>21 sought after. Then what's going to dictate</p> <p>22 how supply and demand interact, you know, the</p> <p>23 housing market? So that's why I don't agree</p> <p>24 with what -- the way you characterized it.</p> | <p style="text-align: right;">Page 121</p> <p>1 Q. Great.</p> <p>2 Do you have any experience -- so is it</p> <p>3 fair to say that the marketplaces for cadets</p> <p>4 on military posts and for medical residents</p> <p>5 are similar, not priced being markets as to</p> <p>6 student assignments to schools?</p> <p>7 A. I would say the cadet assignment</p> <p>8 market is not exactly a nonprice market</p> <p>9 because they have this very interesting</p> <p>10 feature that, as a cadet, you are able to</p> <p>11 express a bid. The bid is not exactly a price</p> <p>12 in the conventional sense, but what it is is</p> <p>13 an opportunity to extend your service</p> <p>14 commitment.</p> <p>15 So roughly speaking, every cadet who</p> <p>16 graduates from West Point has to do three</p> <p>17 years of an active duty service obligation.</p> <p>18 But the way the military has set up the system</p> <p>19 is if I am interested in a spot in a highly</p> <p>20 sought-after branch, like combat arms, for</p> <p>21 instance, that could be sought after because</p> <p>22 that's a branch that leads many people to</p> <p>23 become generals. Okay?</p> <p>24 I can indicate in the matching system</p> |

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1 a willingness to extend my commitment beyond  
2 three years. So I would think that -- of that  
3 as a price. In fact, our model of the system  
4 in my paper in the "American Economic Review"  
5 calls this a price, but really, it's an  
6 extension of the term of the contract. So  
7 that -- that's where I just put a kind of  
8 fine -- fine comb on that particular example.  
9 So it's more of a hybrid auction matching  
10 system there.  
11 Q. Sure. But there is no literal price;  
12 you agree to that? I think you said that  
13 earlier.  
14 MR. CHANG: Objection. Form.  
15 A. I don't know what the word "literal  
16 price" means. So if you look at my paper on  
17 this, we call it a -- a price -- a multiprice  
18 cumulative offer algorithm is the algorithm  
19 that's used. So the price here is the terms  
20 of the trade. So am I getting assigned combat  
21 arms for a three-year commitment or a  
22 five-year commitment? So that price.  
23 In economics, the way we usually think  
24 about a price is it involves a marginal rate

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1 of substitution. So how much am I willing to  
2 trade off one thing versus the other? That's  
3 proportional to the price. You can think of  
4 that analogy as a price. I'm willing to trade  
5 off a higher rank choice. I really want to do  
6 combat arms, and I'm even willing to do it for  
7 two extra years as opposed to my next-best  
8 alternative. So I would call that a price.  
9 BY MR. RYBNICEK:  
10 Q. My question was is there currency  
11 exchanged? I'll put it simply that way.  
12 A. Okay. Not in that market, no, yeah.  
13 Q. Or in the student assignments to  
14 schools marketplace or the medical residents  
15 to internships marketplace, correct?  
16 A. In the medical residents marketplace,  
17 the only place where they charge you is -- so  
18 I believe, unlike the school examples, when  
19 you apply and go through the National Resident  
20 Matching System, you have to pay to set up an  
21 account. And if you are interested in ranking  
22 more than their standard number of choices,  
23 you also have to pay an extra amount to do  
24 that. So that's currency, yeah.

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1 Q. There's no competing -- is there just  
2 one medical residency matching program  
3 nationally?  
4 A. In the United States, my understanding  
5 is the vast majority of medical residents get  
6 their placement through a -- the NRMP, but  
7 there's also placements that happen outside of  
8 the NRMP. One example of that is what they  
9 call the scramble. So every year, there are  
10 participants in the NRMP who don't get any of  
11 their choices. So this happens every year in  
12 Boston. We have match dates typically in  
13 March, and if you're someone who doesn't get a  
14 placement through that clearinghouse, you get  
15 a phone call two days before.  
16 I had a friend go through this. It's  
17 a really devastating thing because you didn't  
18 get any of your choices. None of your choices  
19 wanted you. Maybe it's because you didn't  
20 rank enough places. And so you go through a  
21 distinct process that is outside of the  
22 National Resident Matching Program to get a  
23 placement. I believe it's on the order of the  
24 30,000 participants, about 1,000 participants

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1 a year go through that system.  
2 Q. Is it fair to say that is a much  
3 smaller pool of the residents that go through  
4 that system?  
5 A. That aftermarket scramble system?  
6 Q. Yes.  
7 A. Yeah, that's right. 1,000 is a  
8 fraction of 30,000.  
9 Q. So for all intents and purposes, there  
10 is a primary marketplace without a competing  
11 marketplace?  
12 MR. CHANG: Objection. Form.  
13 A. Well, this is for the primary  
14 residency match. If you go to some specialty  
15 matches, they have different rules. So --  
16 BY MR. RYBNICEK:  
17 Q. Sure.  
18 A. -- for the primary residency matching  
19 place, a large majority of American medical  
20 school graduates receive their first placement  
21 through the NRMP, yeah.  
22 Q. So it strikes me that the ad tech  
23 industry is very different than the three  
24 examples you've provided in Paragraph 35. And

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| <p style="text-align: right;">Page 126</p> <p>1 is it -- for one, is it the case that ad tech<br/> 2 functions based on price and quality?<br/> 3 MR. CHANG: Objection. Form.<br/> 4 A. In the markets that I've described,<br/> 5 quality is an incredibly important dimension.<br/> 6 So everyone would give an arm and a<br/> 7 leg to get a placement at Mass. General<br/> 8 Hospital down the street here. So that's very<br/> 9 important.<br/> 10 The same criteria applies for<br/> 11 medical -- I'm sorry -- for military branch<br/> 12 assignment. You know, as I said a second ago,<br/> 13 there are certain branch assignments that are<br/> 14 particularly sought after. They are<br/> 15 considered higher quality ones, the fast track<br/> 16 to become general.<br/> 17 And on the school side, quality is<br/> 18 paramount. So a lot of my papers actually<br/> 19 talk about ways to measure quality, and<br/> 20 they -- I've actually worked in several cities<br/> 21 on improving the way that quality is measured,<br/> 22 including in New York City, where they're --<br/> 23 currently, if you go to the New York City<br/> 24 website and look at the quality ratings of</p> | <p style="text-align: right;">Page 128</p> <p>1 the right to basically short-sell a stock or a<br/> 2 bond.<br/> 3 And those are studies that I didn't<br/> 4 mention here, but they're on my CV.<br/> 5 MR. CHANG: Counsel, before we<br/> 6 go any further, whenever you get to a good<br/> 7 stopping place, we've been on the record for a<br/> 8 little while now.<br/> 9 MR. RYBNICEK: Okay. Just maybe<br/> 10 one or two questions.<br/> 11 BY MR. RYBNICEK:<br/> 12 Q. Is -- but it's fair to say that the<br/> 13 three examples you list in Paragraph 35 are<br/> 14 your predominant experience -- representing<br/> 15 your predominant experience?<br/> 16 MR. CHANG: Objection.<br/> 17 BY MR. RYBNICEK:<br/> 18 Q. Is that fair?<br/> 19 MR. CHANG: Form.<br/> 20 A. It's hard for me really to know what<br/> 21 the word "predominant experience" means. So<br/> 22 in terms of the cadet branch matching example,<br/> 23 I have written more papers on the housing<br/> 24 market and more papers on securities lending</p> |
| <p style="text-align: right;">Page 127</p> <p>1 schools, it's our product. It's our lab --<br/> 2 Blueprint Labs from MIT's metric for measuring<br/> 3 quality.<br/> 4 So I disagree with the quality piece<br/> 5 of what you brought up.<br/> 6 Q. Sure.<br/> 7 A. In terms of the exchange of currency,<br/> 8 these three markets do not involve the<br/> 9 exchange of currency.<br/> 10 Q. Have you worked on -- have markets<br/> 11 where the price component is a problem been a<br/> 12 part of any of your research?<br/> 13 A. Yes. I have worked on other markets<br/> 14 that are not listed here but that are on my<br/> 15 CV. So one example is the market for real<br/> 16 estate agents. I have several papers on<br/> 17 conflicts of interest in how real estate<br/> 18 agents are paid.<br/> 19 I've also done several studies of the<br/> 20 housing market. So in housing, there is a<br/> 21 price, so that includes studies of foreclosure<br/> 22 discounts or studies of rent control.<br/> 23 On the finance side, I've done studies<br/> 24 of securities lending, which involve prices of</p>                                                                                 | <p style="text-align: right;">Page 129</p> <p>1 shorting financial instruments than I've<br/> 2 written on cadet branch matching markets.<br/> 3 On the medical residents topic, I have<br/> 4 written two papers on that topic. And so I've<br/> 5 done more than two papers on real estate<br/> 6 agents. So I've worked on many different<br/> 7 markets. So this is just a snapshot of some<br/> 8 of the ones that we've listed here in<br/> 9 Paragraph 35. So I would disagree with the<br/> 10 "predominant" word there.<br/> 11 BY MR. RYBNICEK:<br/> 12 Q. Certainly, the work on student<br/> 13 assignments to school, I think we talked<br/> 14 earlier, that is your predominant research?<br/> 15 A. That's the topic I worked on the most,<br/> 16 correct, yes.<br/> 17 MR. RYBNICEK: We can take a<br/> 18 break.<br/> 19 MR. CHANG: Sounds good.<br/> 20 THE VIDEOGRAPHER: The time is<br/> 21 12:00 p.m. We're off the record.<br/> 22<br/> 23 (Recess taken from 12:00 p.m.<br/> 24 to 12:47 p.m.)</p>                     |



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| <p style="text-align: right;">Page 130</p> <p>1</p> <p>2 THE VIDEOGRAPHER: We are back</p> <p>3 on the record. The time is 12:47.</p> <p>4 BY MR. RYBNICEK:</p> <p>5 Q. Great. So, Professor, did you discuss</p> <p>6 the substance of your deposition with counsel</p> <p>7 during our lunch break?</p> <p>8 MR. CHANG: I'm going to</p> <p>9 instruct the witness not to answer consistent</p> <p>10 with the expert stipulation.</p> <p>11 BY MR. RYBNICEK:</p> <p>12 Q. Will you heed your counsel's advice?</p> <p>13 A. I will, yes.</p> <p>14 Q. So I want to get back to your market</p> <p>15 design principles.</p> <p>16 Can you explain what the market design</p> <p>17 principles you applied in forming your</p> <p>18 opinions in this case?</p> <p>19 A. The principles that I focused on are</p> <p>20 associated with Professor Alvin Roth's</p> <p>21 framework that are described in his book "Who</p> <p>22 Gets What and Why" and his American Economic</p> <p>23 Association presidential lecture on</p> <p>24 marketplaces, markets, and market design.</p>                                                                                                    | <p style="text-align: right;">Page 132</p> <p>1 preamble "to function properly," is that kind</p> <p>2 of longhand for "to be efficient"?</p> <p>3 MR. CHANG: Objection. Form.</p> <p>4 A. My view of what Roth is doing in that</p> <p>5 quote is allowing for other objectives beyond</p> <p>6 efficiency. So functioning properly could</p> <p>7 involve things like being fair.</p> <p>8 The reason I think that is, Roth and I</p> <p>9 have worked together in some of the projects</p> <p>10 that I've undertaken assisting school</p> <p>11 districts with their assignment processes, and</p> <p>12 efficiency is a consideration, but fairness is</p> <p>13 a consideration as well as transparency of the</p> <p>14 rules. So that phrase "to function properly,"</p> <p>15 "properly" is a catchall for the various</p> <p>16 objectives stakeholders have in mind.</p> <p>17 Q. Okay. You've identified efficiency,</p> <p>18 fairness, transparency.</p> <p>19 Is there anything else you think is</p> <p>20 captured in the phrase "to function</p> <p>21 properly"?</p> <p>22 A. It's a fairly broad term, "functioning</p> <p>23 properly." So the usual exercise in market</p> <p>24 design has as its origins the technical field</p> |
| <p style="text-align: right;">Page 131</p> <p>1 Roth outlines a set of goals for</p> <p>2 well-designed marketplaces. One goal is</p> <p>3 efficiency. Another goal is thickness.</p> <p>4 Another goal is safety. And another goal is</p> <p>5 congestion -- eliminating congestion. Those</p> <p>6 are the key pillars of the framework that I</p> <p>7 used in my report.</p> <p>8 Q. So I'm looking at Paragraph 39. And I</p> <p>9 see in Subbullet 1, thickness; Subbullet 2,</p> <p>10 safety; and, 3, congestion. I think you also</p> <p>11 said efficiency?</p> <p>12 A. Uh-huh.</p> <p>13 Q. Is that represented in one of those</p> <p>14 three that you identified explicitly in</p> <p>15 Paragraph 39, or is it elsewhere?</p> <p>16 A. Efficiency is elsewhere in the report,</p> <p>17 not in Paragraph 39.</p> <p>18 But if we go back to Paragraph 34, I</p> <p>19 talk about one common consideration is</p> <p>20 marketplace efficiency.</p> <p>21 Q. I guess what I'm trying to get at is</p> <p>22 Paragraph 39 says, "To function properly,</p> <p>23 markets need to do at least three things," and</p> <p>24 I take it you're quoting Dr. Roth here. That</p> | <p style="text-align: right;">Page 133</p> <p>1 of microeconomics that's called mechanism</p> <p>2 design, where we analyze a social system as a</p> <p>3 function that takes certain inputs to an</p> <p>4 output. And the way that mechanism design</p> <p>5 theory operates is we examine desirable</p> <p>6 properties of outcomes, so fairness,</p> <p>7 efficiency.</p> <p>8 Neutrality is an example of a</p> <p>9 condition. Neutrality, you can think of as a</p> <p>10 form of nondiscrimination. So we can be</p> <p>11 mathematically rigorous about what that might</p> <p>12 mean.</p> <p>13 So if I have two agents who have the</p> <p>14 same exact characteristics, they should get</p> <p>15 the same outcome. That would be one possible</p> <p>16 definition of neutrality that would depend on</p> <p>17 the setting at hand. But that's a common</p> <p>18 definition. And this is a branch of economics</p> <p>19 that's called axiomatic resource allocation,</p> <p>20 something I've done research on, where we</p> <p>21 specify these goals. So that's what</p> <p>22 "functioning properly" means to me.</p> <p>23 So another goal is what's called equal</p> <p>24 treatment of equals. Equal treatment of</p>            |

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| <p style="text-align: right;">Page 134</p> <p>1 equals is a philosophical principle that dates<br/> 2 to Aristotle actually. You can think of it as<br/> 3 a fairness requirement, but it's very similar<br/> 4 to the idea that I just described. In certain<br/> 5 settings, equal treatment of equals means two<br/> 6 individuals who are reporting the same<br/> 7 information to the function, to a system<br/> 8 should get the same exact outcome.<br/> 9 And what Roth pioneered among other<br/> 10 economists, Shapley as well, is results that<br/> 11 say, given these goals for a system, the only<br/> 12 mechanism or only function that takes inputs<br/> 13 into outputs is, say, a second-price auction<br/> 14 or -- I've given you a couple of examples of<br/> 15 goals, but there's -- that's by no means<br/> 16 exhaustive.<br/> 17 So another goal that is often<br/> 18 described is what we would call goals related<br/> 19 to incentive compatibility. So that's jargon<br/> 20 in economics for we want to ensure<br/> 21 participants have the right incentives in the<br/> 22 system.<br/> 23 So the strongest version of that<br/> 24 condition is what we call strategy proofness.</p>                                    | <p style="text-align: right;">Page 136</p> <p>1 doesn't matter if you're behaving honestly.<br/> 2 You're not penalized for that, so you don't<br/> 3 have to look at the particular aspects -- this<br/> 4 was in the context of the school assignment<br/> 5 system here in Boston. So that's just by way<br/> 6 of example of the types of goals that we would<br/> 7 say are behind a properly functioning market.<br/> 8 Q. Okay. You listed quite a few.<br/> 9 Fairness, efficiency, transparency,<br/> 10 neutrality, equal treatment of equals,<br/> 11 incentive, compatibility.<br/> 12 A. (Witness nodding.)<br/> 13 Q. Do markets need to have all of these?<br/> 14 A. They don't need to have all of these.<br/> 15 The relevance of these properties depends on<br/> 16 the particular setting at hand. Let me give<br/> 17 you an example.<br/> 18 So earlier today we talked about<br/> 19 allocating dorm rooms to MIT undergraduates,<br/> 20 and if I were to impose the requirement of<br/> 21 equal treatment of equals, one thing that you<br/> 22 realize is that the only way to get to an<br/> 23 outcome where two individuals who have the<br/> 24 same rankings over dorm rooms get the same</p>                           |
| <p style="text-align: right;">Page 135</p> <p>1 So that's a term that folks use who study<br/> 2 mechanism design, and that is a requirement<br/> 3 that no matter what anyone else is doing, you<br/> 4 have -- you can do no better than reveal your<br/> 5 private information honestly. So that's a<br/> 6 goal that's related to the procedural<br/> 7 dimensions of a mechanism that's distinct from<br/> 8 the consequences of the mechanism, the<br/> 9 outcomes of the mechanism. So there's a class<br/> 10 of goals like that that people have in mind<br/> 11 when designing systems.<br/> 12 So for instance, when I have been<br/> 13 involved with Professor Roth and also<br/> 14 independently in designing school assignment<br/> 15 mechanisms, one goal for a properly<br/> 16 functioning market is strategy proofness. In<br/> 17 fact, when the superintendent of Boston talked<br/> 18 about that goal for functioning properly, he<br/> 19 articulated a very important rationale for<br/> 20 strategy proofness, which is you want to<br/> 21 ensure that the system is fair to people who<br/> 22 don't understand the rules.<br/> 23 So if you don't understand the rules,<br/> 24 when you have a strategy proof system, it</p> | <p style="text-align: right;">Page 137</p> <p>1 outcome is by using something that's not<br/> 2 deterministic, but it's random.<br/> 3 So equal treatment of equals,<br/> 4 Aristotle's idea truly is one rationale for<br/> 5 ending up with a randomized mechanism, a<br/> 6 mechanism that's, you know, in the simplest<br/> 7 case, just a pure lottery.<br/> 8 And another goal that I haven't talked<br/> 9 about but that's also relevant is concept of<br/> 10 auditability. We can verify what the outcomes<br/> 11 of the mechanism are. After the mechanism has<br/> 12 been run, we can verify it. And sometimes<br/> 13 people have a view -- and this, of course,<br/> 14 depends on the setting -- that when you have a<br/> 15 mechanism that's based on the outcome of a<br/> 16 lottery, it's challenging to tell an audit<br/> 17 whether the mechanism was run as intended<br/> 18 because, in the case of dorm assignment, we<br/> 19 can implement that mechanism where we draw<br/> 20 numbers out of a, you know, urn in front of<br/> 21 everybody, or we could do it on a computer and<br/> 22 say, You got, you know, your first choice, and<br/> 23 you got your last choice.<br/> 24 In the latter implementation, it's</p> |



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| <p style="text-align: right;">Page 138</p> <p>1 very difficult to verify that the mechanism is</p> <p>2 determine -- is implemented as promised. So</p> <p>3 this is just to show an example of a setting</p> <p>4 where goals can be in conflict. So</p> <p>5 auditability plus equal treatment of equals</p> <p>6 are conflicting goals.</p> <p>7 Q. And so who decides which of these are</p> <p>8 applicable and when?</p> <p>9 MR. CHANG: Objection. Form.</p> <p>10 A. Well, that's this kind of central</p> <p>11 starting task of a market designer, to look at</p> <p>12 the existing institution and study what are</p> <p>13 the reasons -- another economist who works in</p> <p>14 this field is an economist named Tayfun</p> <p>15 Somnez, and he's coined the expression what</p> <p>16 are the root causes for why an existing</p> <p>17 institution is not successfully realizing some</p> <p>18 of the goals of stakeholders, and the way he</p> <p>19 thinks about it complements the Roth</p> <p>20 framework. It's the role of the market</p> <p>21 designer to diagnose the root causes of market</p> <p>22 failures and understand whether there are</p> <p>23 changes to design rules that eliminate the</p> <p>24 root causes of the market failures.</p> | <p style="text-align: right;">Page 140</p> <p>1 A. (Witness nodding.)</p> <p>2 Q. Do you see that?</p> <p>3 A. I do, yes.</p> <p>4 Q. And so am I right that those are the</p> <p>5 market principles, those three things?</p> <p>6 MR. CHANG: Objection. Form.</p> <p>7 MR. RYBNICEK: I'm sorry.</p> <p>8 What's the objection?</p> <p>9 MR. CHANG: I think he's stated</p> <p>10 before that there are other considerations.</p> <p>11 Maybe I misunderstood your question.</p> <p>12 BY MR. RYBNICEK:</p> <p>13 Q. Well, what we, I thought, were talking</p> <p>14 about were the characteristics of a properly</p> <p>15 functioning market or the goals. Now I'm</p> <p>16 asking you what are the principles of market</p> <p>17 design, which I had understood are these three</p> <p>18 elements of thickness, safety, and overcoming</p> <p>19 congestion? Is that the right way to think</p> <p>20 about it?</p> <p>21 A. Maybe I'd draw your attention to the</p> <p>22 exact sentence here. It says, "Roth</p> <p>23 summarizes that to function properly, markets</p> <p>24 need to at least -- do at least three things."</p>                                                                                                                                  |
| <p style="text-align: right;">Page 139</p> <p>1 So the answer, in general, depends on</p> <p>2 the specific context that you have in mind,</p> <p>3 but I can give you an example from the</p> <p>4 military example.</p> <p>5 BY MR. RYBNICEK:</p> <p>6 Q. That's okay.</p> <p>7 A. Okay.</p> <p>8 Q. We might come back to it, though.</p> <p>9 So these are all potential market</p> <p>10 goals or attributes of a properly functioning</p> <p>11 market?</p> <p>12 A. (Witness nodding.)</p> <p>13 Q. Is that right?</p> <p>14 A. It's what I have given you is not an</p> <p>15 exhaustive list.</p> <p>16 Q. Fair enough.</p> <p>17 A. But they are examples, yes.</p> <p>18 Q. And then Roth goes on to say, to</p> <p>19 function properly -- that's what we've been</p> <p>20 talking about -- market needs to do at least</p> <p>21 three things. And then that's where this list</p> <p>22 of thickness, safety, and congestion -- or</p> <p>23 overcoming congestion comes into play.</p> <p>24 Do you see that?</p>                                                                                                                                                                                                                                                   | <p style="text-align: right;">Page 141</p> <p>1 So these are three key pillars, but</p> <p>2 there are also other ones. And if you look at</p> <p>3 Paragraph 40, I discuss, "In my own research,</p> <p>4 I have found that markets become thick when</p> <p>5 they encourage participation. They become</p> <p>6 safe when participants have transparency and</p> <p>7 when participants have straightforward</p> <p>8 incentives."</p> <p>9 So as we were just discussing, the</p> <p>10 idea of strategy proofness or straightforward</p> <p>11 incentives can be seen as a goal in and of</p> <p>12 itself, or it can be part of the safety</p> <p>13 characteristic that Roth has under No. 2. In</p> <p>14 fact, if you look at the history of how this</p> <p>15 field of mechanism design developed, it's</p> <p>16 something that in the 1970s, economists said,</p> <p>17 Let's try to look at mechanisms where the goal</p> <p>18 itself is strategy proofness. So the famous</p> <p>19 results of economic theorists in the 1970s,</p> <p>20 which, by the way, I taught to my</p> <p>21 undergraduates about a month ago, was a</p> <p>22 characterization of all functions that are</p> <p>23 strategy proof.</p> <p>24 And so I would say that could be a</p> |

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| <p style="text-align: right;">Page 142</p> <p>1 goal in and of itself, strategy proofness.<br/> 2 Okay? So that would be under "function<br/> 3 properly."<br/> 4 That could also be an attribute that,<br/> 5 you know, why -- back to the Boston example,<br/> 6 we want a strategy proof system because we<br/> 7 want it to be safe for people, you know, who<br/> 8 are participating in the system to reveal<br/> 9 their private information.<br/> 10 Q. I think I understand, which is the<br/> 11 market principles that you have focused on are<br/> 12 thickness, safety, congestion, as well as<br/> 13 participation, transparency, and<br/> 14 straightforward incentives; is that fair?<br/> 15 A. These are the main ones that I focused<br/> 16 on in this particular market, yes.<br/> 17 Q. So could you tell me what market<br/> 18 thickness means?<br/> 19 A. I have a precise definition in my<br/> 20 report here on page 15. So market thickness<br/> 21 is "to bring together a large enough<br/> 22 proportion of potential buyers and sellers to<br/> 23 produce satisfactory outcomes for both sides<br/> 24 of a transaction."</p>                                                | <p style="text-align: right;">Page 144</p> <p>1 talks about in his book. That is the market<br/> 2 for paired kidney exchange. Okay? So one of<br/> 3 the reasons why the market design framework<br/> 4 has been so powerful in economics is because<br/> 5 of the work that economists like Al Roth did<br/> 6 to try to orGansize the way in which patients<br/> 7 who need kidney transplants are able to obtain<br/> 8 exchanges.<br/> 9 So what's the idea? Every one of us<br/> 10 has two kidneys. Let's say my wife has<br/> 11 end-stage renal failure. I would like to be<br/> 12 able to donate my kidney to her, but I might<br/> 13 not be biologically compatible.<br/> 14 And let's imagine you're in the same<br/> 15 kind of situation. Your partner needs a<br/> 16 kidney. You can't donate your kidney to your<br/> 17 partner. What if I donated my kidney to your<br/> 18 partner and you donated your kidney to my<br/> 19 partner? That's called a pairwise exchange.<br/> 20 And one of the things that Roth and<br/> 21 several other economists have worked on for<br/> 22 about 20 years is how to set up markets for<br/> 23 paired exchange in the United States. And one<br/> 24 of the main frictions in that market is that</p> |
| <p style="text-align: right;">Page 143</p> <p>1 Q. And how do you determine how much<br/> 2 thickness is sufficient?<br/> 3 A. You'd have to look at a specific<br/> 4 context to come to an understanding of this.<br/> 5 One example that comes to mind are financial<br/> 6 markets.<br/> 7 So we tend to see that when we have<br/> 8 trading taking place on exchanges where<br/> 9 participants are able to come and transact. A<br/> 10 large number -- the assets, like stocks,<br/> 11 many -- many, let's say, large-cap stocks<br/> 12 involve many buyers and potential sellers<br/> 13 transacting at the same time so that there are<br/> 14 opportunities for buyers to find many<br/> 15 potential sellers and vice versa, many sellers<br/> 16 to find potential buyers.<br/> 17 If we had an example of a stock that<br/> 18 is illiquid or what people in finance<br/> 19 sometimes call pink sheet stocks, those are<br/> 20 stocks where there are not many potential<br/> 21 buyers or potential sellers. And so in that<br/> 22 situation, you would say that's a thin market.<br/> 23 Let me give you another example that's<br/> 24 maybe closer to what Roth has worked on and he</p> | <p style="text-align: right;">Page 145</p> <p>1 the possibility for paired exchanges are<br/> 2 limited to regional markets.<br/> 3 So there used to be a thing called the<br/> 4 New England program for kidney exchange run<br/> 5 out of Mass. General Hospital right here. And<br/> 6 wouldn't it be great if we could have the New<br/> 7 England program work together with the Toledo,<br/> 8 Ohio, program, work together with the WashU<br/> 9 St. Louis program and the San Antonio program?<br/> 10 And that would be great because the market<br/> 11 becomes thicker. There are many more possible<br/> 12 opportunities for patients who need kidneys to<br/> 13 find potential matches and donors to find<br/> 14 recipients who can receive their orGans. So<br/> 15 it would be better to have a thick market by<br/> 16 integrating all of these markets.<br/> 17 Q. That is because a patient in --<br/> 18 sorry -- I think you said St. Louis could<br/> 19 match with somebody in Boston and could match<br/> 20 with somebody in Florida?<br/> 21 A. Exactly right. But the markets, as<br/> 22 they stand today, are regionalized, and so<br/> 23 those potential gains from trade don't occur.<br/> 24 Q. So less fragmentation --</p>   |

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| <p style="text-align: right;">Page 146</p> <p>1 A. Correct.</p> <p>2 Q. -- would be better?</p> <p>3 A. Yeah, yeah.</p> <p>4 Q. And how does this apply in the ad tech</p> <p>5 sector?</p> <p>6 A. So the way thickness is important for</p> <p>7 the ad tech sector is we want to maximize the</p> <p>8 opportunities for participants in the market</p> <p>9 to find matches. So what that means is a</p> <p>10 publisher wants to be able to be unencumbered</p> <p>11 in finding an advertiser who will generate the</p> <p>12 most surplus from allowing the advertiser to</p> <p>13 have access to inventory on the publisher's</p> <p>14 web page, and likewise, the advertiser wants</p> <p>15 to have the opportunity to find a publisher</p> <p>16 who is able to, just like in our kidney</p> <p>17 example, find the publisher, say, the donor</p> <p>18 who is most likely to have a compatible</p> <p>19 kidney. The advertiser here would like to</p> <p>20 find inventory that is going to best meet</p> <p>21 their goals as an advertiser.</p> <p>22 Q. And so as in the kidney example, does</p> <p>23 that mean one big exchange would be</p> <p>24 preferential?</p>                                                                                                              | <p style="text-align: right;">Page 148</p> <p>1 So there are papers in this field that</p> <p>2 have looked at this issue. Is it sufficient</p> <p>3 to just regionalize exchanges, you know, more</p> <p>4 than they currently are, or do we need to have</p> <p>5 a fully integrated market? And my view of</p> <p>6 that literature is it's not quite settled how</p> <p>7 far we need to go to a completely unified</p> <p>8 market.</p> <p>9 So it depends a little bit on the</p> <p>10 technological constraints to answer that</p> <p>11 precisely for the kidney market.</p> <p>12 Q. Sorry. I thought earlier you said it</p> <p>13 would be better and more -- it would result in</p> <p>14 thicker markets to consolidate and have less</p> <p>15 fragmented kidney exchange marketplaces.</p> <p>16 A. (Witness nodding.)</p> <p>17 Q. Do you agree with that?</p> <p>18 A. As a general principle, but there are</p> <p>19 also costs of doing surgeries, of trans- --</p> <p>20 you know, flying from Seattle to Miami to do a</p> <p>21 surgery. So those benefits need to be weighed</p> <p>22 against those costs. And there are papers</p> <p>23 that try to undertake this exercise using data</p> <p>24 and, you know, kind of completely -- if</p> |
| <p style="text-align: right;">Page 147</p> <p>1 MR. CHANG: Objection. Form.</p> <p>2 A. I haven't studied that one close</p> <p>3 enough to know whether a single exchange is</p> <p>4 preferable or maybe two or three exchanges.</p> <p>5 You know, one of the challenges in the</p> <p>6 kidney market -- and this is where knowing the</p> <p>7 institutional details is really important --</p> <p>8 is that in some places in the United States,</p> <p>9 you can do a paired exchange. And a paired</p> <p>10 exchange requires four distinct surgeries, and</p> <p>11 those surgeries have to take place at the same</p> <p>12 exact instance. So that's what the medical</p> <p>13 ethics community has determined.</p> <p>14 I can't first take my wife's kidney</p> <p>15 out of her and give it to your partner because</p> <p>16 what if you change your mind and do not give</p> <p>17 your kidney to my wife? So for that reason,</p> <p>18 we have this constraint that surgeries have to</p> <p>19 take place simultaneously.</p> <p>20 There are a handful of centers in the</p> <p>21 United States where they can accommodate six</p> <p>22 simultaneous surgeries. So one place is</p> <p>23 Toledo, Ohio, actually that can accommodate</p> <p>24 six simultaneous surgeries.</p> | <p style="text-align: right;">Page 149</p> <p>1 there's no costs, you know, a very robust</p> <p>2 intuition is to maximize the possibility of</p> <p>3 finding a match, having more trading partners</p> <p>4 on both sides is good.</p> <p>5 So I'm just bringing up, you know,</p> <p>6 that two way versus three way as an example of</p> <p>7 a type of friction you would want to account</p> <p>8 for.</p> <p>9 Q. So your point is that there are also</p> <p>10 potential downsides or costs associated with</p> <p>11 achieving greater thickness?</p> <p>12 A. As a general matter, we would have to</p> <p>13 think about those and weigh them against the</p> <p>14 benefits of being able to find more trading</p> <p>15 partners.</p> <p>16 MR. CHANG: Professor, before we</p> <p>17 go any further, you've been doing a good job</p> <p>18 of this, but if you could, please, for the</p> <p>19 benefit of the court reporter, respond with</p> <p>20 yeses and nos as best you can.</p> <p>21 THE WITNESS: Okay.</p> <p>22 BY MR. RYBNICEK:</p> <p>23 Q. What's the ideal structure of the ad</p> <p>24 exchange market?</p>                                                                                                                           |

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| <p style="text-align: right;">Page 150</p> <p>1 MR. CHANG: Objection. Form.</p> <p>2 And -- witness may answer.</p> <p>3 A. Let me start with some attributes of</p> <p>4 the ideal structure.</p> <p>5 One attribute is the market should</p> <p>6 bring together all participants who are</p> <p>7 interested in transacting ads should aspire to</p> <p>8 thickness.</p> <p>9 Another attribute is the market should</p> <p>10 have the appropriate incentives for</p> <p>11 participants to act or reveal their private</p> <p>12 information. So that's this kind of safety</p> <p>13 dimension.</p> <p>14 And the congestion dimension is, I</p> <p>15 think, most closely related to simultaneity of</p> <p>16 trades. So when Roth talks about congestion,</p> <p>17 he's really thinking about time as a way to</p> <p>18 clear the markets rather than price. And when</p> <p>19 you have simultaneous trading, what happens is</p> <p>20 we can ensure that the prices reflect the</p> <p>21 underlying demand and supply patterns in the</p> <p>22 market, and it's not a consequence of</p> <p>23 segmentation or what Roth calls early</p> <p>24 contracting.</p>                                                                                                                                                                        | <p style="text-align: right;">Page 152</p> <p>1 and we should do this in a way that's</p> <p>2 eliminating other factors, like time, as ways</p> <p>3 to clear the market.</p> <p>4 BY MR. RYBNICEK:</p> <p>5 Q. Sure. That's helpful. I guess I'm</p> <p>6 trying to think through this a little bit more</p> <p>7 systematically.</p> <p>8 A. Okay.</p> <p>9 Q. How would you identify the right</p> <p>10 structure to achieve thickness, which is one</p> <p>11 of the principles for market design that</p> <p>12 you've outlined?</p> <p>13 A. I would -- to identify thickness, I</p> <p>14 would ask the question are there potential</p> <p>15 participants who would be interested in</p> <p>16 trading or potential matches that might have</p> <p>17 occurred that did not? And if I saw</p> <p>18 large-scale evidence of that phenomena, I</p> <p>19 would say that is a market that's not thick.</p> <p>20 And we would then ask what could we do</p> <p>21 to ensure those participants who wanted to</p> <p>22 trade, whether it's a publisher who's</p> <p>23 interested in reaching some advertisers that</p> <p>24 they cannot or vice versa, an advertiser who</p>                                                                 |
| <p style="text-align: right;">Page 151</p> <p>1 And one of the reasons why</p> <p>2 centralization is beneficial in certain</p> <p>3 situations is that it prevents what Roth calls</p> <p>4 unraveling. So that's the reason why the</p> <p>5 medical match looms so large in Roth's book,</p> <p>6 because that underlies the entire framework</p> <p>7 that Roth is talking about as a key example.</p> <p>8 So prior to the existence of the</p> <p>9 matching program, residency programs used to</p> <p>10 compete on time, and this is -- this happens</p> <p>11 in many industries. So if you're trying to</p> <p>12 hire folks to clerk for the Supreme Court, for</p> <p>13 instance, the time in which you have to agree</p> <p>14 to commitments to clerk for district courts is</p> <p>15 unraveled to early on in law school. And when</p> <p>16 time becomes a factor, people are forced to</p> <p>17 make decisions without full information.</p> <p>18 So to go back and make sure I'm</p> <p>19 answering your question right, so the ideal</p> <p>20 structure should try to bring together all of</p> <p>21 the participants so that we can find the gains</p> <p>22 in trade, make sure those participants have</p> <p>23 the appropriate incentives to reveal their</p> <p>24 values and know how to transact in the system,</p> | <p style="text-align: right;">Page 153</p> <p>1 wants to find a publisher that they find</p> <p>2 particularly valuable, we would see how --</p> <p>3 whether that's occurring, what are the</p> <p>4 obstacles to that occurring, and to make the</p> <p>5 market thick, we would try to combat those</p> <p>6 obstacles.</p> <p>7 Q. And putting aside other factors, would</p> <p>8 you be assured of -- strike that.</p> <p>9 Putting aside other factors, would you</p> <p>10 be able to achieve thickness by bringing</p> <p>11 together everybody in one exchange?</p> <p>12 A. I would say that bringing more people</p> <p>13 on to the same exchange would be a step</p> <p>14 towards thickness. If you did that in a way</p> <p>15 that was, you know, frictional, if you brought</p> <p>16 people to an exchange where you charged, you</p> <p>17 know, certain participants different prices</p> <p>18 than other participants to participate, then</p> <p>19 that would create bottlenecks to bringing</p> <p>20 people together and realizing the gains from</p> <p>21 trade.</p> <p>22 So in a completely frictionless</p> <p>23 environment where everyone comes to the bazaar</p> <p>24 to trade, that would be a way to achieve</p> |

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| <p style="text-align: right;">Page 154</p> <p>1 thickness.</p> <p>2 Q. And that's kind of what has happened</p> <p>3 in the school assignment to school marketplace</p> <p>4 and the cadet marketplace and the -- what was</p> <p>5 the third example we talked --</p> <p>6 A. Medical match.</p> <p>7 Q. Medical match.</p> <p>8 That's one way that they've achieved</p> <p>9 thickness, right, is by having one centralized</p> <p>10 marketplace right?</p> <p>11 A. I'd say that's the aspiration. One</p> <p>12 place on the school side that has not been as</p> <p>13 successful involves segmentation between</p> <p>14 different types of public schools.</p> <p>15 So earlier we talked about My Schools</p> <p>16 DC [sic]. What was remarkable about My</p> <p>17 Schools DC in 2012, '13, that time period, is</p> <p>18 that the traditional public schools and the</p> <p>19 charter schools in Washington, D.C., came</p> <p>20 together and participated on the same platform</p> <p>21 so that if there was a child who was</p> <p>22 interested in attending a public school or a</p> <p>23 charter school, they could express that</p> <p>24 information through the clearinghouse and did</p> | <p style="text-align: right;">Page 156</p> <p>1 If you have one exchange, you inherently don't</p> <p>2 have competition with other exchanges.</p> <p>3 Is that a fair observation?</p> <p>4 A. I mean, an example that I would point</p> <p>5 to that's distinct from what you just</p> <p>6 described is, if you look down the hall here,</p> <p>7 it says the Boston Stock Exchange, right? So</p> <p>8 in the United States, we have several</p> <p>9 different stock exchanges, ESX, Philadelphia</p> <p>10 Stock Exchange, and then we have the New York</p> <p>11 Stock Exchange. We have NASDAQ. Now, whether</p> <p>12 these are exchanges or not, they are places</p> <p>13 where people can trade, so they're distinct</p> <p>14 exchanges.</p> <p>15 And the way that system is structured</p> <p>16 is we have rules in that marketplace that</p> <p>17 people call the National Best Bid Offer rules,</p> <p>18 NBBO rules, that ensure that you're not</p> <p>19 getting discriminated against by virtue of</p> <p>20 transacting in the Boston Stock Exchange</p> <p>21 versus the Philadelphia Stock Exchange.</p> <p>22 So you could look at that and say it's</p> <p>23 not a unified market. It's fragmented. There</p> <p>24 are these different venues for which you could</p> |
| <p style="text-align: right;">Page 155</p> <p>1 not have to go through two separate processes</p> <p>2 and worry about congestion and the timing of</p> <p>3 the offers from one process versus the other</p> <p>4 process.</p> <p>5 And that pattern has been replicated</p> <p>6 in several other cities that I've worked in,</p> <p>7 but it has not always worked out that way. So</p> <p>8 there are some places where we still have</p> <p>9 distinct enrollment processes across different</p> <p>10 types of schools. And so I don't like that.</p> <p>11 I think it's a bad idea. I've written about</p> <p>12 that because it's getting in the way of</p> <p>13 thickness.</p> <p>14 Q. So is thick -- is achieving greater</p> <p>15 thickness in conflict with competition?</p> <p>16 MR. CHANG: Objection. Form.</p> <p>17 A. No.</p> <p>18 BY MR. RYBNICEK:</p> <p>19 Q. Well, I think we just talked about an</p> <p>20 example in which having centralized</p> <p>21 marketplaces, including even a centralized ad</p> <p>22 exchange, would create the greatest amount of</p> <p>23 thickness because you'd have all the</p> <p>24 participants participating in one exchange.</p>                 | <p style="text-align: right;">Page 157</p> <p>1 trade. But they have designed the market in a</p> <p>2 way to ensure that we reach some of the market</p> <p>3 design goals that are -- that are here.</p> <p>4 Q. But those are -- those markets are</p> <p>5 less thick than a single ad exchange market</p> <p>6 would be?</p> <p>7 A. Well, because we have this National</p> <p>8 Best Bid Offer rules, you can be assured, as a</p> <p>9 participant, that by transacting in one venue,</p> <p>10 you're not losing very much. The offers there</p> <p>11 have to be competitive with offers on other</p> <p>12 venues.</p> <p>13 So it's possible to, you know, have</p> <p>14 different exchanges with interoperability that</p> <p>15 allow for the forces of competition to be</p> <p>16 present.</p> <p>17 Q. It's possible.</p> <p>18 I guess my -- are all the stocks</p> <p>19 available on all the exchanges?</p> <p>20 A. I don't know off the top of my head.</p> <p>21 Q. But isn't that a key part of the</p> <p>22 thickness we're talking about? The</p> <p>23 centralized ad exchange we're talking about</p> <p>24 has all the participants transacting all the</p>                                                                                                           |



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| <p style="text-align: right;">Page 158</p> <p>1 ad impressions.</p> <p>2 What you're describing is fragmented</p> <p>3 and has some exchanges with some stocks and</p> <p>4 other exchanges with other stocks.</p> <p>5 A. Uh-huh.</p> <p>6 Q. Reading your report, it sounds like</p> <p>7 that is a less efficient, fragmented, less</p> <p>8 thick marketplace.</p> <p>9 A. It's true that some stocks are traded</p> <p>10 only on NASDAQ. Some stocks are only traded</p> <p>11 on the NYC, but that -- would it be better if</p> <p>12 everything were integrated in that specific</p> <p>13 situation?</p> <p>14 I'm saying because they have these</p> <p>15 rules, equitable interoperability-type rules,</p> <p>16 these NBBO rules, the efficiency loss there</p> <p>17 may not be very large.</p> <p>18 So as a participant, if I'm interested</p> <p>19 in buying Tesla stock in -- on BSX versus a</p> <p>20 different exchange, I'm able to do that</p> <p>21 without suffering efficiency loss.</p> <p>22 If I'm interested in a very</p> <p>23 specialized product, so if the decision is</p> <p>24 should I buy Tesla versus a different stock or</p> | <p style="text-align: right;">Page 160</p> <p>1 ad exchanges should there be?</p> <p>2 MR. CHANG: Objection. Form.</p> <p>3 BY MR. RYBNICEK:</p> <p>4 Q. You can answer.</p> <p>5 A. Can I answer? Okay.</p> <p>6 It's something we'd have to think</p> <p>7 about very carefully because, as I just</p> <p>8 described, we could have many exchanges that</p> <p>9 operate with each other in an equitable way</p> <p>10 where there's nondiscrimination across the</p> <p>11 exchanges or rules like the rules we see in</p> <p>12 some financial markets, and that could be one</p> <p>13 possible structure. So that would involve</p> <p>14 multiple exchanges. Another structure could</p> <p>15 involve a smaller number of exchanges with</p> <p>16 interoperability.</p> <p>17 Q. So if there's interoperability, you</p> <p>18 would need fewer exchanges?</p> <p>19 A. Not necessarily.</p> <p>20 Q. Well, the example you just gave is one</p> <p>21 structure is -- we could have many exchanges</p> <p>22 that operate with each other in an equitable</p> <p>23 way where there's nondiscrimination across</p> <p>24 exchanges or -- I'm sorry. I'm reading back</p>                                                                   |
| <p style="text-align: right;">Page 159</p> <p>1 something distinct, then I may have to only do</p> <p>2 that on certain venues. Like, if I want to</p> <p>3 buy a stock or a bond, for instance, that's a</p> <p>4 different venue.</p> <p>5 So -- yeah, let me stop there.</p> <p>6 Q. To achieve optimal thickness, how many</p> <p>7 ad exchanges should there be?</p> <p>8 MR. CHANG: Objection. Form.</p> <p>9 Counsel, we're straying into the</p> <p>10 remedies portion of all of this. Can I</p> <p>11 understand how this bears on liability?</p> <p>12 MR. RYBNICEK: His opinion is</p> <p>13 that the market is -- that Google has acted</p> <p>14 anticompetitively, and he can tell that</p> <p>15 because the market design is inefficient. I'm</p> <p>16 asking what the efficient design is. I'm not</p> <p>17 asking him how he would change Google. I'm</p> <p>18 asking him how many ad exchanges should there</p> <p>19 be to achieve his market principle of</p> <p>20 thickness.</p> <p>21 BY MR. RYBNICEK:</p> <p>22 Q. Do you want me to repeat the question?</p> <p>23 A. Sure.</p> <p>24 Q. To achieve optimal thickness, how many</p>       | <p style="text-align: right;">Page 161</p> <p>1 your last statement. And then there would be</p> <p>2 another structure that could involve a smaller</p> <p>3 number of exchanges with interoperability.</p> <p>4 So are you describing two scenarios in</p> <p>5 which you have interoperability, one with a</p> <p>6 lot of exchanges and one with fewer?</p> <p>7 A. Right. What I'm trying to get at, to</p> <p>8 answer your question, is to talk about what is</p> <p>9 the ideal structure. It's not as simple as</p> <p>10 saying the number of exchanges. The other</p> <p>11 dimensions of how the market is structured are</p> <p>12 relevant, like interoperability rules, and are</p> <p>13 we going to impose that each of the exchanges</p> <p>14 is revealing the same kind of information to</p> <p>15 participants about the transactions, so on and</p> <p>16 so forth. So I can't say should it be one or</p> <p>17 should it be ten without having more details</p> <p>18 like that.</p> <p>19 Q. But you've determined that Google is</p> <p>20 acting anticompetitively because -- strike</p> <p>21 that.</p> <p>22 Are market -- ad tech markets thick</p> <p>23 today?</p> <p>24 A. I think there are many opportunities</p> |



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| <p style="text-align: right;">Page 162</p> <p>1 for gains from trade that do not exist during</p> <p>2 the time period of my report because</p> <p>3 participants are not able to easily access</p> <p>4 different sources of demand on the publisher</p> <p>5 side and advertisers are not easily able to</p> <p>6 access different publishers because of the</p> <p>7 fragmentation and other things that I talk</p> <p>8 about in my report.</p> <p>9 Q. So again, I mean, you said the</p> <p>10 fragmentation. That would suggest the</p> <p>11 consolidation would help thickness; is that</p> <p>12 fair?</p> <p>13 A. It depends on how things are</p> <p>14 consolidated. So if we have consolidation in</p> <p>15 which if you use a preferred partner, you get</p> <p>16 a discount but if you're using a nonpreferred</p> <p>17 partner, you're charged more, it's not obvious</p> <p>18 to me that consolidation in and of itself is</p> <p>19 sufficient to increase thickness.</p> <p>20 I could consolidate and say either you</p> <p>21 and I trade or everyone in this room trades,</p> <p>22 but if everyone in this room is who is not</p> <p>23 wearing a blue suit is trading, we're going to</p> <p>24 tax them 50 percent. Even though that's a</p> | <p style="text-align: right;">Page 164</p> <p>1 determine their venues. And ideally, they</p> <p>2 have full information to make those decisions</p> <p>3 that reflect their interests in the best</p> <p>4 possible way.</p> <p>5 BY MR. RYBNICEK:</p> <p>6 Q. So you're not saying that a publisher</p> <p>7 has to use multiple exchanges; is that fair?</p> <p>8 A. Yes.</p> <p>9 Q. So it's perfectly fine for a publisher</p> <p>10 to choose to use AdX and only AdX?</p> <p>11 MR. CHANG: Objection. Form.</p> <p>12 A. It depends under the circumstances</p> <p>13 whether they make that choice. So if -- you</p> <p>14 know, as I describe it, it's a Hobson's</p> <p>15 choice. It's a choice that's truly not a</p> <p>16 choice when -- if you are trying to, as a</p> <p>17 publisher, access demand and the only way you</p> <p>18 can access Google Ads' demand is by using AdX,</p> <p>19 it's preventing the publisher from realizing</p> <p>20 certain matches. So I would say that's a bad</p> <p>21 market design.</p> <p>22 BY MR. RYBNICEK:</p> <p>23 Q. Do you know how many advertisers is on</p> <p>24 Google Ads' multihome?</p> |
| <p style="text-align: right;">Page 163</p> <p>1 consolidated market, I don't necessarily think</p> <p>2 that would be a thick market and a market that</p> <p>3 would realize the surplus maximization.</p> <p>4 Q. Would kind of an ideal thick market,</p> <p>5 do all the exchanges need to have access to</p> <p>6 all the demand and supply?</p> <p>7 A. In the hypothetical ideal, the market</p> <p>8 design ideal, it should be possible for</p> <p>9 participants to find their best matches on</p> <p>10 both sides. So those -- that would be the --</p> <p>11 what I would aspire to, yes.</p> <p>12 Q. So matches that are available on AdX</p> <p>13 should also be available on multiple other ad</p> <p>14 exchanges? Is that your view of the market</p> <p>15 design?</p> <p>16 MR. CHANG: Objection. Form.</p> <p>17 A. The participants in the market should</p> <p>18 be able to make those decisions themselves.</p> <p>19 So if it turns out there's a venue that the</p> <p>20 advertisers and the publishers prefer for</p> <p>21 various reasons, maybe the quality of ads that</p> <p>22 are transacted in that venue are somehow</p> <p>23 better or different, then I believe that</p> <p>24 participants should have the free choices to</p>  | <p style="text-align: right;">Page 165</p> <p>1 A. Right off the top of my head, no, I</p> <p>2 don't.</p> <p>3 Q. Are you familiar with the concept of</p> <p>4 multihoming?</p> <p>5 A. Yes.</p> <p>6 Q. What's the concept of multihoming?</p> <p>7 A. Multihoming is when you transact on</p> <p>8 more than one platform. Google Ads' demand is</p> <p>9 exclusive to AdX.</p> <p>10 Q. Do advertisers using Google Ads use</p> <p>11 other buying tools?</p> <p>12 A. That's certainly possible.</p> <p>13 Q. You don't know?</p> <p>14 A. Right off the top of my head, the</p> <p>15 number who do that, I don't know.</p> <p>16 Q. As part of your analysis, you're not</p> <p>17 aware of whether advertisers use --</p> <p>18 advertisers using Google Ads also use other</p> <p>19 buying tools?</p> <p>20 A. No, I am aware that that occurs. What</p> <p>21 I don't know off the top of my head is the</p> <p>22 fraction of the market that multihomes.</p> <p>23 Q. And if it was -- is your analysis the</p> <p>24 same if the fraction that multihomes is 5</p>                                                                             |

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| <p style="text-align: right;">Page 166</p> <p>1 percent versus 75 percent?</p> <p>2 A. The analysis about Google Ads is that</p> <p>3 Google Ads is exclusive to AdX. So if I'm an</p> <p>4 advertiser who wants to be able to find</p> <p>5 trading partners on AdX, then I'm unable to do</p> <p>6 that without the Google Ads tool. So that's</p> <p>7 bad for market efficiency because we're</p> <p>8 getting in the way of potential matches</p> <p>9 forming.</p> <p>10 Now, the kind of real-world evidence</p> <p>11 here is difficult to process because the</p> <p>12 information that advertisers have to make</p> <p>13 those choices, as I discuss in my report, is</p> <p>14 confounded by many of the conducts in this</p> <p>15 case. So whether I decide to multihome or</p> <p>16 not, if I'm doing experiments on where am I</p> <p>17 going to get better matches because of, say,</p> <p>18 inflation from certain Google conducts,</p> <p>19 changing bids, et cetera, that information is</p> <p>20 difficult to process and make informed choices</p> <p>21 about.</p> <p>22 Q. With all due respect, I think the</p> <p>23 most -- of that answer was not responsive, but</p> <p>24 I'm going to try again --</p> | <p style="text-align: right;">Page 168</p> <p>1 says, Who's willing to trade with this</p> <p>2 particular buyer?</p> <p>3 And so if I use a buying tool, I want</p> <p>4 to be able to find the best possible matches</p> <p>5 from that buying tool. And right now, that</p> <p>6 buying tool, if it's not Google Ads, is not</p> <p>7 able to access AdX demand.</p> <p>8 Q. But why do you get to dictate who a</p> <p>9 buying tool transacts with?</p> <p>10 MR. CHANG: Objection. Form.</p> <p>11 A. I'm diagnosing the problems with the</p> <p>12 current structure from the market design lens</p> <p>13 that I have. So it would be better for a</p> <p>14 buying tool to be able to, if it were truly</p> <p>15 representing the interests of the buyers, look</p> <p>16 for transactions that are best for those</p> <p>17 buyers. And the current structure does not</p> <p>18 allow those buyers using a non-Google tool to</p> <p>19 access AdX.</p> <p>20 BY MR. RYBNICEK:</p> <p>21 Q. And the buyers continue to use AdX --</p> <p>22 excuse me -- Google Ads?</p> <p>23 A. Buyers use Google Ads. That's a true</p> <p>24 statement.</p> |
| <p style="text-align: right;">Page 167</p> <p>1 A. Okay.</p> <p>2 Q. -- which is advertisers using Google</p> <p>3 Ads also use other buying tools; is that your</p> <p>4 understanding?</p> <p>5 A. Yes.</p> <p>6 Q. And so they can reach transactions</p> <p>7 with other exchanges using other buying tools;</p> <p>8 is that correct?</p> <p>9 A. Yes.</p> <p>10 Q. And that is a form of market</p> <p>11 thickness, correct?</p> <p>12 A. It depends on the terms in which they</p> <p>13 can reach those other transactions. So if I</p> <p>14 want to reach transactions on AdX, I can't do</p> <p>15 it on the buying side unless I'm using Google</p> <p>16 Ads because Google Ads is exclusive to AdX.</p> <p>17 Q. But why does -- why do other buying</p> <p>18 tools need to have access to AdX?</p> <p>19 A. The buying tools should be</p> <p>20 representing the interest of buyers. So a</p> <p>21 buying tool should be furthering the</p> <p>22 opportunity of a buyer to find potential</p> <p>23 trading partners. And so a way a buying tool</p> <p>24 does that is by looking out in the market and</p>                                                                                                            | <p style="text-align: right;">Page 169</p> <p>1 Q. And are you aware of -- well, strike</p> <p>2 that.</p> <p>3 Do your students, can they take</p> <p>4 classes at Harvard?</p> <p>5 A. MIT students can take classes at</p> <p>6 Harvard, yes.</p> <p>7 Q. Can they take classes at NYU?</p> <p>8 A. As far as I know, yes.</p> <p>9 Q. As part of their admission into MIT?</p> <p>10 A. I mean, I have students who have come</p> <p>11 to MIT with several semesters of advanced</p> <p>12 mathematics classes at NYU.</p> <p>13 Q. Let me try it this way. Can a Harvard</p> <p>14 student not admitted into MIT take your course</p> <p>15 at MIT?</p> <p>16 A. We have an arrangement with Harvard,</p> <p>17 and MIT that allows that, yes.</p> <p>18 Q. Can every university send their</p> <p>19 students to your -- to take a class with</p> <p>20 you?</p> <p>21 A. No.</p> <p>22 Q. And why is that?</p> <p>23 A. They weren't admitted. There's no</p> <p>24 arrangement between MIT and the other</p>                                                                                                                                        |

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1 universities.

2 Q. Wouldn't it be a thicker market, so to

3 speak, if all students could take your class?

4 A. I mean, I'm not a buyer or a seller.

5 I don't see myself as a professor that's

6 selling something. So, I mean, this is why

7 some of my colleagues write textbooks, because

8 they're able to expand their reach.

9 Q. But why don't you allow somebody from

10 the University of North Carolina to attend

11 your classes?

12 A. As actually --

13 MR. CHANG: Objection. Form.

14 A. As a matter of fact, if there's

15 someone who shows up at MIT -- this is

16 happening right now, this fall -- who wants to

17 audit my class, I allow them to sit in my

18 class, and I have several auditors taking my

19 class right now. I don't even know what

20 university they're from, but it's a way for me

21 to expand my reach and reach those students,

22 which I think is good.

23 Now, I am employed by MIT, so MIT has

24 certain rules about whether those students are

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1 able to get credit without having to pay

2 tuition and stuff. But I even give some of

3 those students shadow grades. If they ask me

4 to write a recommendation letter for them, I

5 also do that because I think that's good for

6 my educational mission as a professor, to

7 teach as many students as possible.

8 Q. But they don't get a credit; is that

9 true?

10 A. Yes, as far as I understand. If

11 you're not registered at MIT for a course, you

12 don't get credit.

13 Q. Well, that's what I was getting at.

14 Thank you.

15 A. Okay.

16 Q. The second principle is safety. Can

17 you tell me how you apply that principle?

18 A. Yes. So the definition of "safety"

19 that I have in my report is the following:

20 "It must be safe. It must be the case that

21 participants who have been brought together

22 reveal or act on confidential information that

23 they hold in a safe way. When a good market

24 outcome depends on such disclosure, as it

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1 often does, the markets must offer

2 participants incentives to reveal some of what

3 they know."

4 So we have safety at several levels in

5 the open web display advertising exchange

6 market as well as the other markets here. One

7 involves "How should you bid in an auction?"

8 And so in my report, I talk about Google's

9 auction manipulations, making it challenging

10 for participants to know how to bid in an

11 auction because several of those auction

12 manipulations have not been disclosed.

13 For instance, reserve price

14 optimization was in effect for over a year.

15 And in my review of the record, I've seen,

16 say -- Google product manager [REDACTED]

17 [REDACTED]

18 [REDACTED]. So if

19 I'm a publisher trying to decide what reserve

20 price I should set, if Google is overriding

21 that choice, I would say that's not an example

22 of a safe environment for the publisher to

23 reveal what reserve price is in their best

24 interest.

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1 Another example of something that gets

2 in the way of safety is the Bernanke auction

3 manipulation wherein Google is changing the

4 ads submitted by bidders and not disclosing

5 that to market participants.

6 So an advertiser whose bids are being

7 manipulated would potentially behave

8 differently. They would potentially learn

9 about their different bidding strategies had

10 they known that their bids were being inflated

11 or deflated by Google's system. So that

12 advertiser would not think of the system as a

13 safe system.

14 The third example is Google's conduct

15 vis-a-vis Dynamic Revenue Share, Version 1,

16 which market participants don't have enough

17 information to figure out whether their bid

18 will be in the region in which Google converts

19 the auction essentially to a first-price

20 format, where the advertiser has to pay their

21 bid. In that region, the advertiser would

22 change their bid. And so they don't know that

23 that's occurring, so it's not safe for the

24 advertiser to act on the confidential

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| <p style="text-align: right;">Page 174</p> <p>1 information, in this case, their evaluation</p> <p>2 for the slot.</p> <p>3 So those are three places where</p> <p>4 safety's showing up in my analysis.</p> <p>5 Q. I guess, taking the last one first,</p> <p>6 Dynamic Revenue Share, your concern related to</p> <p>7 advertisers not knowing how Dynamic Revenue</p> <p>8 Share adjusted publishers' floors?</p> <p>9</p> <p>10 (Stenographer clarification.)</p> <p>11</p> <p>12 A. My understanding of Dynamic Revenue</p> <p>13 Share is that it's changing the take rates in</p> <p>14 the auctions. And by changing the take rates</p> <p>15 in a way to steer activity to AdX, it creates</p> <p>16 incentives for advertisers to potentially</p> <p>17 behave differently. And Google, as I talk</p> <p>18 about at length in my report -- and I can pull</p> <p>19 up some examples of that -- has not disclosed</p> <p>20 that to advertisers.</p> <p>21 They also didn't disclose</p> <p>22 DRS Version 1 to publishers. So Paragraph</p> <p>23 188, I talk about -- "For DRS V1, AdX</p> <p>24 dynamically decreased its take rate to clear</p> | <p style="text-align: right;">Page 176</p> <p>1 Like in the markets that I've been</p> <p>2 involved in designing, we have information</p> <p>3 from -- the West Point example. There are</p> <p>4 videos upon videos describing exactly how the</p> <p>5 system works to clear that market. And that's</p> <p>6 essential to ensure participants know how to</p> <p>7 react to the market-clearing rules.</p> <p>8 So I believe an advertiser should know</p> <p>9 what rules they're bidding into, yes, what the</p> <p>10 rules of the auction are.</p> <p>11 BY MR. RYBNICEK:</p> <p>12 Q. When you say "rules of the auction,"</p> <p>13 that includes the take rate or the revenue</p> <p>14 share?</p> <p>15 A. Correct, yes, because it affects their</p> <p>16 incentives. So we want to make it safe for</p> <p>17 them to act on their confidential information.</p> <p>18 That is their evaluation for the slot. But as</p> <p>19 a revenue share varies -- as a function of</p> <p>20 what bids are submitted, that affects their</p> <p>21 optimal response, and advertisers should have</p> <p>22 the opportunity to best respond with as much</p> <p>23 information as possible.</p> <p>24 Q. Have you done an analysis of the</p>       |
| <p style="text-align: right;">Page 175</p> <p>1 more impressions while making sure that its</p> <p>2 average take rate did not go below 19 percent.</p> <p>3 However, Google never disclosed this conduct</p> <p>4 to advertisers or publishers who sell or buy</p> <p>5 impressions."</p> <p>6 And there's documents between Google</p> <p>7 staff [REDACTED]</p> <p>8 [REDACTED]</p> <p>9 [REDACTED]</p> <p>10 [REDACTED] So that creates an environment that's</p> <p>11 not safe for participants to behave in.</p> <p>12 BY MR. RYBNICEK:</p> <p>13 Q. And it's your view that advertisers</p> <p>14 should always know what the publisher-side</p> <p>15 tool take rate is?</p> <p>16 MR. CHANG: Objection. Form.</p> <p>17 A. In a transparent market, advertisers</p> <p>18 should have information that allows them to</p> <p>19 bid optimally. So in the case of DRS, if the</p> <p>20 take rate is dynamically adjusted in a way</p> <p>21 that affects the incentives of advertisers,</p> <p>22 they should be aware of that. That's a core</p> <p>23 principle of market design folks who work on</p> <p>24 designing market clearing rules.</p>   | <p style="text-align: right;">Page 177</p> <p>1 effect of DRS on the ad tech market?</p> <p>2 A. I have discussed DRS in my report. So</p> <p>3 I can point you to Section B, page 69.</p> <p>4 Q. Can you tell me whether it benefited</p> <p>5 or harmed publishers overall based on your</p> <p>6 analysis?</p> <p>7 MR. CHANG: Objection. Form.</p> <p>8 A. My starting point for that question is</p> <p>9 the fact that Google did this and did not</p> <p>10 disclose. It suggests to me that it benefited</p> <p>11 Google. And had advertisers known about DRS,</p> <p>12 they would potentially behave differently.</p> <p>13 So understanding how they would behave</p> <p>14 different would be important to understand</p> <p>15 whether they benefited from this or not.</p> <p>16 But, you know, if you think about an</p> <p>17 advertiser whose bid is now cleared on AdX</p> <p>18 because of DRS, that advertiser might have</p> <p>19 gotten a better deal elsewhere. The publisher</p> <p>20 whose ad is now being sold on AdX, thanks to</p> <p>21 DRS, might have gotten different terms</p> <p>22 elsewhere. So those are the kind of possible</p> <p>23 things that could occur.</p> <p>24 That's now DRS v1 plus v2, where</p> |

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| <p style="text-align: right;">Page 178</p> <p>1 there's this debit mechanism, which makes</p> <p>2 things even more complicated for participants</p> <p>3 to understand how the rules work with DRS v1</p> <p>4 for reducing the take rate.</p> <p>5 With v2, we're sometimes charging a</p> <p>6 higher take rate to publishers. So there will</p> <p>7 be instances where publishers are potentially</p> <p>8 harmed by the higher take rate. So these are</p> <p>9 the types of things that can happen.</p> <p>10 BY MR. RYBNICEK:</p> <p>11 Q. You just listed things that could</p> <p>12 happen, and you identified there being</p> <p>13 potential scenarios in which parties could or</p> <p>14 could not be harmed. I asked you a different</p> <p>15 question, which is have you done an analysis</p> <p>16 of whether publishers overall are harmed by</p> <p>17 DRS?</p> <p>18 A. The fact that publishers do not have</p> <p>19 the choice with DRS v1 is in and of itself</p> <p>20 evidence that they were harmed, that they</p> <p>21 didn't have the opportunity to turn it on or</p> <p>22 off with v1.</p> <p>23 Q. Even if they made more money?</p> <p>24 A. They didn't have the choice. Whether</p>                                                           | <p style="text-align: right;">Page 180</p> <p>1 DRS?</p> <p>2 A. I'm not sure that question is kind of</p> <p>3 the question of my analysis here. My concern</p> <p>4 with DRS is that publishers were not able to</p> <p>5 choose that they wanted this feature or not.</p> <p>6 Q. That's fine. I appreciate that's not</p> <p>7 a concern of your analysis.</p> <p>8 A. Yeah.</p> <p>9 Q. I'm asking if you know. If you don't</p> <p>10 know, that's fine because it's not part of</p> <p>11 your analysis. I'm asking do you know if</p> <p>12 publishers came out better or worse off as a</p> <p>13 result of DRS?</p> <p>14 A. I mean, what I've talked about in my</p> <p>15 report are examples of publishers expressing</p> <p>16 confusion about DRS. So whether they're</p> <p>17 harmed or not, we'd have to look at the</p> <p>18 evidence for that. And without publishers</p> <p>19 knowing exactly what DRS is, I would be very</p> <p>20 skeptical as to what that evidence is.</p> <p>21 And we'd also need to know what their</p> <p>22 outside options were. Where else would their</p> <p>23 inventory potentially have transacted? Would</p> <p>24 it have been better for them to engage in a</p>         |
| <p style="text-align: right;">Page 179</p> <p>1 they made more money, one would need to know</p> <p>2 what would have happened to those publishers</p> <p>3 on other, you know, exchanges, et cetera, and</p> <p>4 publishers would need to have full information</p> <p>5 about how DRS versus a world without DRS</p> <p>6 affects their overall revenue. So they didn't</p> <p>7 have that choice. They were forced. It</p> <p>8 wasn't disclosed that DRS 1 was taking place.</p> <p>9 Q. Whether they had a choice or not</p> <p>10 doesn't tell you if they made more money or</p> <p>11 less money versus the but-for world,</p> <p>12 correct?</p> <p>13 A. Yeah. But your question earlier was</p> <p>14 about harm. So the fact that they did not</p> <p>15 have a choice is, you know, I think,</p> <p>16 preventing them from being able to figure out</p> <p>17 whether this was good for them, exercising the</p> <p>18 freedom to choose, which is an important</p> <p>19 consideration in competitive markets. So it's</p> <p>20 possible some publishers got some benefit;</p> <p>21 some publishers on particular auctions got</p> <p>22 lower benefits.</p> <p>23 Q. It's fair to say you don't know how</p> <p>24 publishers came out overall as a result of</p> | <p style="text-align: right;">Page 181</p> <p>1 different type of transaction?</p> <p>2 Go ahead.</p> <p>3 Q. Is it your testimony that you cannot</p> <p>4 determine whether or not publishers are better</p> <p>5 or worse off as a result of DRS?</p> <p>6 A. What I've looked at is the fact that</p> <p>7 publishers did not have information about</p> <p>8 DRS's existence and could not make a choice.</p> <p>9 My kind of base instinct is publishers are,</p> <p>10 you know, the folks who should figure out</p> <p>11 whether they want, you know, DRS or not. They</p> <p>12 are in the best position to make that</p> <p>13 decision, not the exchange operator.</p> <p>14 Q. I guess I'm still asking the question</p> <p>15 of -- it sounds like the answer is no, but</p> <p>16 have you done an analysis to determine whether</p> <p>17 publishers are better or worse off as a result</p> <p>18 of DRS?</p> <p>19 MR. CHANG: Objection. Form.</p> <p>20 A. My analysis, using the principles of</p> <p>21 DRS, the fact that the take rate is</p> <p>22 dynamically adjusted would show that some</p> <p>23 publishers might have benefited in some</p> <p>24 situations and other publishers may not have.</p> |



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| <p style="text-align: right;">Page 182</p> <p>1 But publishers did not have the information to</p> <p>2 make the informed choice as to whether they</p> <p>3 wanted to do this or not.</p> <p>4 BY MR. RYBNICEK:</p> <p>5 Q. So we're getting closer.</p> <p>6 A. Okay.</p> <p>7 Q. Some benefited. Some may not have.</p> <p>8 Overall, do you know if publishers</p> <p>9 were worse or better off financially as a</p> <p>10 result of DRS?</p> <p>11 A. It's a very difficult -- I mean, I'll</p> <p>12 go back to what we were talking about a second</p> <p>13 ago. What we need to do to answer that</p> <p>14 question is we need to say, Let's not put</p> <p>15 Bernanke. Let's not put a lot of the other</p> <p>16 conducts here, reserve price optimization, and</p> <p>17 look at an experiment where there is DRS and</p> <p>18 there's not DRS, and look at publisher yields</p> <p>19 in those environments compared to what</p> <p>20 publishers would have done if there was no</p> <p>21 DRS. And so that analysis is not in my report</p> <p>22 because these conducts are all overlapping,</p> <p>23 right? So it's difficult to ascribe a</p> <p>24 particular publisher's revenue, you know, in a</p>           | <p style="text-align: right;">Page 184</p> <p>1 are not able to obey the principles of market</p> <p>2 design. They don't have safety in making</p> <p>3 their choices about reserve prices.</p> <p>4 On top of that, with both of these</p> <p>5 conducts, DRS and RPO, Google is throttling</p> <p>6 these conducts, making it intentionally</p> <p>7 difficult for publishers to learn how to</p> <p>8 behave vis-a-vis these conducts. So with</p> <p>9 reserve price optimization, I think I would</p> <p>10 trust a publisher to figure out what's the</p> <p>11 right reserve price for them, not an exchange</p> <p>12 who wants to increase the amount of revenue</p> <p>13 that they can generate.</p> <p>14 MR. CHANG: Counsel,</p> <p>15 understanding you have somewhere you want to</p> <p>16 go, whenever is a good time, you let me know</p> <p>17 if we can take a break.</p> <p>18 MR. RYBNICEK: We'll try to wrap</p> <p>19 this up.</p> <p>20 BY MR. RYBNICEK:</p> <p>21 Q. But is it correct to say you have not</p> <p>22 done a -- you have not quantified where the</p> <p>23 publishers are financially better or worse off</p> <p>24 as a result of RPO?</p>                                                                                             |
| <p style="text-align: right;">Page 183</p> <p>1 particular setting to one specific conduct in</p> <p>2 an empirical matter.</p> <p>3 So that's why I retreat back to the</p> <p>4 theoretical incentive underlying DRS. And as</p> <p>5 I said, DRS is steering transactions to AdX.</p> <p>6 That might have helped some publishers and</p> <p>7 hurt others.</p> <p>8 Q. I'm going to try the same thing with</p> <p>9 RPO and Bernanke. And if we can do it faster,</p> <p>10 that would be great, but we'll get it -- we'll</p> <p>11 do it however we have to.</p> <p>12 RPO. Are publishers better or worse</p> <p>13 off as a whole as a result of RPO?</p> <p>14 A. Publishers set reserve prices for many</p> <p>15 reasons. RPO is overriding their ability to</p> <p>16 set reserve prices and learn from the</p> <p>17 different reserve prices that they've set. So</p> <p>18 RPO is harming publishers from being able to</p> <p>19 have control over how they want to sell their</p> <p>20 inventory.</p> <p>21 In particular, publishers had no</p> <p>22 information that RPO is taking place, at least</p> <p>23 in the early year and a half after RPO was</p> <p>24 launched. So that is a sign that publishers</p> | <p style="text-align: right;">Page 185</p> <p>1 A. My analysis is based on the incentives</p> <p>2 that RPO creates. And looking at RPO versus</p> <p>3 not is challenging because of these</p> <p>4 overlapping conducts. So to get to an</p> <p>5 empirical answer like that, I didn't feel the</p> <p>6 need to do that because of these overlapping</p> <p>7 conducts. So that's why I'm talking about the</p> <p>8 incentives that RPO has placed on publishers</p> <p>9 and how it's taken away publisher choice to</p> <p>10 choose a reserve price.</p> <p>11 Q. But as a DRS, some publishers could be</p> <p>12 worse off; some publishers could be better</p> <p>13 off? Is that your opinion?</p> <p>14 A. In certain auctions, yes.</p> <p>15 Q. Bernanke. Have you quantified whether</p> <p>16 advertisers are made better or worse off as a</p> <p>17 result of Bernanke?</p> <p>18 A. Bernanke, again, is a conduct that was</p> <p>19 not disclosed to participants. So publishers</p> <p>20 are in the best position to realize -- to</p> <p>21 determine for themselves whether they want to</p> <p>22 be the recipient of bids that were manipulated</p> <p>23 by Bernanke and, likewise, maybe the</p> <p>24 advertiser side is a better way to describe</p> |



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1 that. Bernanke was not disclosed either to  
 2 publishers or advertisers.  
 3 So by virtue of the fact that it's not  
 4 being disclosed to the participants, one  
 5 wonders why the -- Google is doing these  
 6 things. If it's supposedly to benefit  
 7 publishers and advertisers, I would have  
 8 expected Google to shout that from the  
 9 rooftops, "We're doing this to help you guys,"  
 10 but that's not what I see in the record,  
 11 what's -- any signs of that in the record.  
 12 [REDACTED]  
 13 [REDACTED]  
 14 [REDACTED]  
 15 [REDACTED]  
 16 [REDACTED]  
 17 And I have the direct quote in my report. So  
 18 that's where I have to go now, back to the  
 19 incentive.  
 20 What Bernanke is doing is manipulating  
 21 bids so as to drive more traffic to the ad  
 22 exchange -- AdX exchange. And what that is  
 23 allowing for is the possibility of mismatch.  
 24 So there are certain advertisers who, because

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1 of Bernanke, are getting matched to publishers  
 2 who would not have been matched otherwise.  
 3 And that's all in service of increasing  
 4 revenue on AdX and making -- you know, having  
 5 these adverse effects for publishers.  
 6 So in particular instances, to get to  
 7 the specifics of your question, there can be  
 8 some publishers who have benefited from  
 9 Bernanke.  
 10 Now, Bernanke was a program that was  
 11 happening on average, so sometimes there was  
 12 subsidization. Sometimes there was deflation.  
 13 So I'm not sure that that -- in my review of  
 14 the record, that has been implemented in a  
 15 consistent way. So there can be sometimes  
 16 where you lucked out, sometimes where you did  
 17 not, and for -- likewise, for advertisers.  
 18 Q. But you haven't done an analysis to  
 19 determine whether or not advertisers, as a  
 20 whole, were better or worse off as a result of  
 21 Bernanke?  
 22 A. My analysis is a theoretical analysis,  
 23 so is that what you're asking about?  
 24 Q. You haven't quantified?

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1 A. Well, I'm relying on the incentives  
 2 that Bernanke placed on market participants,  
 3 the fact that Bernanke is not disclosed to  
 4 market participants, and that's the basis for  
 5 my views about Bernanke.  
 6 Q. You said this is based on -- your  
 7 views are based on the fact that Bernanke  
 8 wasn't disclosed. Is anything that's not  
 9 disclosed inefficient or anticompetitive?  
 10 MR. CHANG: Objection. Form.  
 11 MR. RYBNICEK: Strike that.  
 12 BY MR. RYBNICEK:  
 13 Q. Is anything that is not disclosed  
 14 inefficient?  
 15 A. As an abstract matter, the extreme  
 16 case that we had to look at specific  
 17 context --  
 18 Q. Any optimization that's not disclosed  
 19 is inefficient?  
 20 A. That same answer as previously. We  
 21 need to talk about what the optimization is.  
 22 If the optimization is taking traffic and  
 23 steering it all to AdX versus a different  
 24 exchange, then that's going to create some

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1 inefficiency.  
 2 Q. With all due respect, this is starting  
 3 to get a little...  
 4 You said that Bernanke was inefficient  
 5 because it wasn't disclosed.  
 6 A. As well as the fact that the  
 7 incentives of the Bernanke system generate  
 8 mismatches because it's manipulating the bids  
 9 that advertisers are submitting, resulting in  
 10 some advertisers being matched to some  
 11 publishers who wouldn't have been matched but  
 12 for the manipulation.  
 13 Q. But you don't know whether or not that  
 14 was to their benefit or detriment?  
 15 MR. CHANG: Objection. Form.  
 16 A. In some cases, it may have led to a  
 17 match form that wouldn't have formed. In  
 18 other cases, it may have led to mismatches.  
 19 And my view is that publishers and advertisers  
 20 are in the best position to determine for  
 21 themselves whether this conduct is good for  
 22 them or not. And they did not have adequate  
 23 information to make those decisions because of  
 24 the fact Bernanke was not disclosed in any

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| <p style="text-align: right;">Page 190</p> <p>1 real way.</p> <p>2 BY MR. RYBNICEK:</p> <p>3 Q. Is it your opinion that advertisers</p> <p>4 don't have a way of identifying their return</p> <p>5 on investment for their ad purchases?</p> <p>6 A. When Google is undertaking many</p> <p>7 different conducts simultaneously, like</p> <p>8 Bernanke, like reserve price optimization,</p> <p>9 like dynamic revenue sharing, and is doing it</p> <p>10 in a way that involves throttling, which is</p> <p>11 purposely making it difficult for advertisers</p> <p>12 to understand the accuracy of the information</p> <p>13 that advertisers has, is compromised by these</p> <p>14 conducts.</p> <p>15 Q. I'm going to try again.</p> <p>16 Can advertisers determine whether</p> <p>17 their return on investment through -- strike</p> <p>18 that.</p> <p>19 Is it your opinion that advertisers</p> <p>20 cannot determine their return on investment</p> <p>21 when using Google Ads?</p> <p>22 A. My opinion is advertisers cannot find</p> <p>23 an accurate measure of the returns of their</p> <p>24 bidding strategies as a result of Google's</p>                                                                                               | <p style="text-align: right;">Page 192</p> <p>1 advertiser to get accurate information on</p> <p>2 their ROI.</p> <p>3 Q. Sorry. You -- I think you changed my</p> <p>4 question to comparing an advertiser's use of</p> <p>5 Google Ads to a but-for world that is</p> <p>6 undefined.</p> <p>7 I'm asking do Google Ads' advertisers</p> <p>8 know how much they're paying and what they're</p> <p>9 getting in return?</p> <p>10 A. Google Ads' advertisers know how much</p> <p>11 they're paying. That's, you know, billed</p> <p>12 them, so that is something they get to see.</p> <p>13 Q. And what --</p> <p>14 A. What they're getting in return -- if</p> <p>15 I'm advising an advertiser team, the relevant</p> <p>16 question is should I have done something</p> <p>17 differently? And that's where these conducts</p> <p>18 get in the way of Google advertisers being</p> <p>19 able to determine what is my optimal strategy,</p> <p>20 for instance.</p> <p>21 So as a matter of arithmetic, your</p> <p>22 question, how much was I charged, yes, there's</p> <p>23 a bill. How many people clicked on my ad and</p> <p>24 how many people eventually bought my product,</p>                                                                                                      |
| <p style="text-align: right;">Page 191</p> <p>1 conducts and the fact that they are hidden and</p> <p>2 not described and that they are throttled. So</p> <p>3 you can get an estimate, but the question is</p> <p>4 is it an accurate estimate?</p> <p>5 Q. They know how much they're paying for</p> <p>6 their ads, right?</p> <p>7 A. Google's advertisers get charged an</p> <p>8 amount, so they can observe that.</p> <p>9 Q. And they can understand the value of</p> <p>10 the ads that they've placed, correct?</p> <p>11 What they don't understand is -- the</p> <p>12 relevant question is suppose I were to do</p> <p>13 something different. What would have</p> <p>14 happened? Because a way a firm would try to</p> <p>15 do that is maybe they would experiment. They</p> <p>16 would run an A-B test, right, or maybe they</p> <p>17 would have someone on their advertiser bidding</p> <p>18 team say, Well, this is a particular auction</p> <p>19 format. If I had shaded my bid one way or the</p> <p>20 other, this is the amount of revenue that I</p> <p>21 could expect. This is an amount of money that</p> <p>22 I would have to pay.</p> <p>23 And thanks to Google's auction</p> <p>24 manipulations, it is not easy for an</p> | <p style="text-align: right;">Page 193</p> <p>1 if I'm an advertiser that's selling products,</p> <p>2 that's an observable question. But the -- I</p> <p>3 think the question that most advertisers would</p> <p>4 have bidding into an exchange is how should I</p> <p>5 bid into an exchange, and could I have</p> <p>6 optimized my advertising campaigns in a way to</p> <p>7 generate a higher return on investment? And</p> <p>8 thanks to Google's conducts, that is very</p> <p>9 difficult for them to figure out.</p> <p>10 Q. But in order -- the part of the puzzle</p> <p>11 that you're saying is missing is what the</p> <p>12 alternatives are. But in order -- you still</p> <p>13 need to know your present ROI, right? I still</p> <p>14 can't get the answer from you.</p> <p>15 A. Yeah, no, I said, as a matter of</p> <p>16 arithmetic, of course, you get a bill. This</p> <p>17 is how much you paid. You get your</p> <p>18 allocation. This is what you were assigned.</p> <p>19 Right? But I'm -- what I'm saying is, as an</p> <p>20 advertiser, trying to think about what I</p> <p>21 should do, that's far from sufficient for</p> <p>22 figuring out what's the best way for me to</p> <p>23 sell -- advertise my products.</p> <p>24 MR. RYBNICEK: Okay. We can</p> |

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| <p style="text-align: right;">Page 194</p> <p>1 take a break.</p> <p>2 MR. CHANG: Okay.</p> <p>3 THE VIDEOGRAPHER: The time is</p> <p>4 2:05. We're off the record.</p> <p>5</p> <p>6 (Recess taken from 2:05 p.m.</p> <p>7 to 2:25 p.m.)</p> <p>8</p> <p>9 THE VIDEOGRAPHER: We are back</p> <p>10 on the record. The time is 2:25.</p> <p>11 BY MR. RYBNICEK:</p> <p>12 Q. All right. I think you'll know what</p> <p>13 my first question is, which is did you discuss</p> <p>14 the substance of your deposition with your</p> <p>15 counsel?</p> <p>16 MR. CHANG: Consistent with the</p> <p>17 expert stipulation, I instruct the witness not</p> <p>18 to answer.</p> <p>19 A. I'll follow the advice of counsel.</p> <p>20 BY MR. RYBNICEK:</p> <p>21 Q. Thank you.</p> <p>22 So I think where we left off was on</p> <p>23 page 16 now, which discusses or raises the</p> <p>24 principle of congestion.</p>                                                                                                                                                                                                                                                                                                                                                                  | <p style="text-align: right;">Page 196</p> <p>1 early on in medical school.</p> <p>2 So typically, four years of medical</p> <p>3 school. At the end of your second year, you</p> <p>4 would have Boston residents who were</p> <p>5 approached by New York Presbyterian Hospital</p> <p>6 saying, I'm going to jump the gun. I'm going</p> <p>7 to try to get ahead of all of my competitors</p> <p>8 and get you to transact with me, get you to</p> <p>9 agree to work for me.</p> <p>10 And, you know, other places where the</p> <p>11 timing of transactions is problematic in</p> <p>12 market design could be things like when we do</p> <p>13 graduate school admissions. We have a rule</p> <p>14 that no student can be pressured to make a</p> <p>15 decision as to what graduate school they</p> <p>16 attend before April 15th. That's an agreement</p> <p>17 that the American Council on Graduate</p> <p>18 Education has come to terms with to ensure</p> <p>19 that participants have enough time and</p> <p>20 information to make informed choices.</p> <p>21 And congestion is, in my report, this</p> <p>22 market design principle. When I think about</p> <p>23 the sequential nature of dynamic allocation,</p> <p>24 AdX is getting this opportunity to transact</p> |
| <p style="text-align: right;">Page 195</p> <p>1 Can you explain to me how the market</p> <p>2 design principle of congestion or overcoming</p> <p>3 congestion is applied?</p> <p>4 A. Congestion is the idea that market</p> <p>5 participants have enough time to make</p> <p>6 satisfactory choices when faced with a variety</p> <p>7 of alternatives. So when Roth is talking</p> <p>8 about congestion, he's thinking about time as</p> <p>9 a way of clearing the market and not price.</p> <p>10 So let me start with Roth's formulation of</p> <p>11 congestion.</p> <p>12 The centralized marketplace that Roth</p> <p>13 talks about a lot is the medical match, but he</p> <p>14 also talks about other settings where we see</p> <p>15 markets where we have things like exploding</p> <p>16 offers, offers where someone gets to make you</p> <p>17 an offer ahead of someone else, and, as a</p> <p>18 participant, you have to decide should I take</p> <p>19 the offer, or should I wait?</p> <p>20 And that's -- in several real-life</p> <p>21 markets, that's what was the genesis of</p> <p>22 medical match. Medical residents in the 1920s</p> <p>23 and '30s were approached by hospital programs</p> <p>24 and asked, Would you commit to work here? very</p> | <p style="text-align: right;">Page 197</p> <p>1 inventory ahead of other potential sources of</p> <p>2 demand, and that is creating congestion</p> <p>3 because it's the timing of transactions.</p> <p>4 They're getting to go quicker. They're</p> <p>5 getting to go earlier in the priority</p> <p>6 ordering.</p> <p>7 Q. And so your analysis of congestion is</p> <p>8 limited to dynamic allocation?</p> <p>9 A. Let me look.</p> <p>10 So enhanced dynamic allocation is also</p> <p>11 a setting where time is playing a role, you</p> <p>12 know, time in the sense of the jumping ahead</p> <p>13 of the rest of the market.</p> <p>14 The opportunity to -- let's see. So</p> <p>15 let me just look at the other conducts just to</p> <p>16 refresh my memory.</p> <p>17 (Witness reviews document.)</p> <p>18 Those are the two main, dynamic</p> <p>19 allocation and enhanced dynamic allocation.</p> <p>20 Q. And maybe say -- explain to me how</p> <p>21 enhanced dynamic allocation creates more</p> <p>22 congestion.</p> <p>23 A. Enhanced dynamic allocation is giving</p> <p>24 AdX the opportunity to take inventory away</p>                                                                                                                                        |

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| <p style="text-align: right;">Page 198</p> <p>1 from directly negotiated deals that publishers<br/>2 may have had with advertisers. So it's like a<br/>3 medical residency program coming early and<br/>4 saying you have to -- you have the opportunity<br/>5 to transact with me when you don't have full<br/>6 information about what your other alternatives<br/>7 would have been and whether that is good for<br/>8 you or not.<br/>9 So there's a close parallel to using<br/>10 time as a way to contract the priority --<br/>11 prioritization in enhanced dynamic allocation<br/>12 is not giving market participants the means to<br/>13 transact their direct inventory in a way that<br/>14 they would like to.<br/>15 Q. Is enhanced dynamic allocation a<br/>16 feature that publishers can opt in to and out<br/>17 of?<br/>18 A. It's my understanding that the only<br/>19 way you could opt out of enhanced dynamic<br/>20 allocation is by not participating on AdX. So<br/>21 de facto, it's very hard to opt out of<br/>22 enhanced dynamic allocation.<br/>23 Q. And what's your understanding --<br/>24 what's the purpose of enhanced dynamic</p> | <p style="text-align: right;">Page 200</p> <p>1 You know, the example in my mind is<br/>2 always the example of a new Marvel movie and a<br/>3 direct deal that, say, "The New York Times"<br/>4 might have with Marvel Studios to take over<br/>5 the entire screen and say, Here is<br/>6 Spider-Man 2. And so there can be many<br/>7 reasons why "The New York Times" would prefer<br/>8 to show that ad over whatever quality ad they<br/>9 would get from AdX.<br/>10 Q. But you, I think, have said a few<br/>11 times now that you trust publishers to make<br/>12 the decisions that are best for them; is that<br/>13 right?<br/>14 A. That is my -- my default, yes.<br/>15 Q. So if EDA was something that<br/>16 publishers could opt in to or out of and they<br/>17 chose to opt in to it, you trust that that<br/>18 must be beneficial to publishers?<br/>19 MR. CHANG: Objection. Form.<br/>20 A. I think you're describing, if I've<br/>21 understood your question correctly, a<br/>22 hypothetical world.<br/>23 As I just said, publishers -- and let<br/>24 me just read from my report here on page 65.</p> |
| <p style="text-align: right;">Page 199</p> <p>1 allocation?<br/>2 A. I believe Google is trying to get an<br/>3 opportunity to transact ahead of direct deals<br/>4 for certain advertisers on AdX. So the<br/>5 purpose of EDA, from the perspective of Google<br/>6 AdX, is to have more transactions occur on AdX<br/>7 where they can get a share of the revenue<br/>8 compared to, you know, the alternative that<br/>9 publishers would have for direct deals.<br/>10 Q. Do you understand that if Google<br/>11 serves an AdX ad through enhanced dynamic<br/>12 allocation, it has a higher value to the<br/>13 publisher than the direct deal?<br/>14 A. As a matter of the price?<br/>15 Q. As a matter of the revenue received to<br/>16 the publisher.<br/>17 A. Right. In enhanced dynamic<br/>18 allocation, the ad would be served via AdX if<br/>19 it were at a price that's higher than the<br/>20 direct deal. But there could be other reasons<br/>21 why advertisers have direct deals having to do<br/>22 with ad quality. So, as I write in my report,<br/>23 the direct deal inventory is often high-value<br/>24 inventory.</p>                   | <p style="text-align: right;">Page 201</p> <p>1 "Publishers did not have the option to<br/>2 selectively turn off EDA for a selection of<br/>3 their premium inventory available through<br/>4 direct deals."<br/>5 Q. But if publishers were able to turn<br/>6 off EDA, your opinion would be different; is<br/>7 that fair?<br/>8 A. If publishers had full information<br/>9 about what EDA was and, you know, there's no<br/>10 other ongoing conduct that they have full<br/>11 information about, then Google could offer a<br/>12 choice where there's no friction, so no<br/>13 default effects, no inertia, publishers are<br/>14 fully informed about what EDA is. Then<br/>15 publishers would be in the best position to<br/>16 make that decision whether they want to enable<br/>17 EDA or not.<br/>18 Q. I just want to make sure we're talking<br/>19 about the same thing.<br/>20 Is it your opinion that publishers<br/>21 don't know about EDA?<br/>22 A. My opinion, no, is that publishers did<br/>23 not have the option to turn off EDA.<br/>24 Q. But they are aware of EDA?</p>                           |







Page 210

1 [REDACTED]  
2 [REDACTED]  
3 Q. So you mentioned DA and EDA. Any  
4 other aspects of ad tech that you've analyzed  
5 under the reduced congestion element principle  
6 of market design?  
7 A. Let me just go back to my list of the  
8 conducts. So my report has -- and one place  
9 that touches on the congestion topic involves  
10 UPR, unified reserve price, unified pricing  
11 rules. So Professor Milgrom talks about the  
12 possibility of postauction discounts as a  
13 substitute for UPR, and I don't believe that  
14 is an adequate substitute for UPR because it's  
15 postauction. The ones we introduced that were  
16 post were back to the timing of transactions.  
17 So arguing that postauction discounts  
18 are an effective replacement to UPR is  
19 something I don't agree with because  
20 postauction discounts are -- can be clunky,  
21 much like the concern for congestion.  
22 Q. Can you explain to me how -- what you  
23 understand UPR to require?  
24 A. UPR is the requirement of publishers

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1 to set the same reserve price across different  
2 demand sources.  
3 Q. And does -- is UPR -- does UPR violate  
4 or -- excuse me. Does UPR violate your market  
5 design principles?  
6 A. UPR is taking away choice from  
7 publishers to -- let me read exactly what I  
8 say about UPR in my report.  
9 So back to the opening, on page 10,  
10 "Google's unified pricing rules gave  
11 preferential treatment to AdX in Google's  
12 ad-buying tools to the detriment of  
13 publishers. UPR reduced the ability of  
14 publishers to maximize revenue by setting  
15 different reserve prices for distinct demand  
16 sources and limited their ability to ensure  
17 high-quality advertisements. These  
18 restrictions on publisher choice were done to  
19 benefit AdX."  
20 So did I answer your question, sir? I  
21 want to make sure I answered your question.  
22 Q. What I heard you say is that UPR  
23 limited publisher choice and therefore  
24 violated your design principles. But choice

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1 is not a market design principle we've talked  
2 about, I don't think.  
3 A. Choice is inherently linked to  
4 efficiency. If I have a restricted number of  
5 choices, I'm not able to do what's most  
6 efficient for me as a participant in the  
7 market.  
8 If we go back to our earlier  
9 discussion of the definition of efficiency  
10 from microeconomics and the relationship to  
11 competitive markets, an agent in a competitive  
12 model is maximizing their utility. They are  
13 doing what's best in an unconstrained way.  
14 They're only constrained by their budget set.  
15 So when we restrict choice, that's  
16 core to the inefficiencies that emerge. A  
17 publisher, had they wanted to set the same  
18 price floor across different sources of  
19 demand, could have, but Google has limited  
20 that possibility with UPR.  
21 Q. So in order for a market to be  
22 efficient, it has to require -- it has to  
23 maximize choice?  
24 A. In this case, that was the previous

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1 operation. Publishers had the ability to have  
2 separate price floors, and that was taken  
3 away. [REDACTED]  
4 [REDACTED]  
5 [REDACTED]  
6 [REDACTED]  
7 [REDACTED]  
8 [REDACTED]  
9 [REDACTED]  
10 Q. By setting uniform pricing rules,  
11 doesn't that embrace the market principle of  
12 neutrality?  
13 A. I don't see how.  
14 Q. All exchanges are treated equal. It  
15 also -- does it also embrace --  
16 A. Neutrality, just to clarify, is not  
17 the principle that all exchanges are treated  
18 equal. It's that if I'm a participant in a  
19 market -- you know, in an explicit example,  
20 you and I have the same exact preferences,  
21 then we should get the same exact outcome. It  
22 doesn't matter if your name is Parag or if  
23 your name is Abe. If we have the same exact  
24 information -- I'm sorry -- same exact

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| <p style="text-align: right;">Page 214</p> <p>1 preferences, we should be treated the same.</p> <p>2 MR. CHANG: Doctor -- sorry.</p> <p>3 BY MR. RYBNICEK:</p> <p>4 Q. Does it embrace --</p> <p>5 MR. CHANG: One moment.</p> <p>6 Professor, just take a moment. Please</p> <p>7 let the questioner finish his question. The</p> <p>8 last question, he did not get a chance to do</p> <p>9 that.</p> <p>10 THE WITNESS: So sorry.</p> <p>11 BY MR. RYBNICEK:</p> <p>12 Q. Does it embrace the market principle</p> <p>13 of equal treatment of equals?</p> <p>14 A. I would say it does not because these</p> <p>15 are not equals. They are different properties</p> <p>16 of demands across different demand sources.</p> <p>17 Some demands may be higher quality; some may</p> <p>18 be lower quality.</p> <p>19 So true equal treatment of equals,</p> <p>20 what's essential is that we have identical</p> <p>21 agents, and the whole point of publishers</p> <p>22 wanting the opportunity to have differential</p> <p>23 reserve prices is that the attributes of</p> <p>24 demand differ across those different venues.</p>                                                            | <p style="text-align: right;">Page 216</p> <p>1 got the slot, and they were willing to pay</p> <p>2 more for that slot. And that is in accordance</p> <p>3 with the person they're transacting with, the</p> <p>4 publisher. And so if the publisher decides to</p> <p>5 have differential reserve prices across</p> <p>6 different exchanges, it's their discretion to</p> <p>7 say what truly counts as a justified instance</p> <p>8 of envy, and so you've taken that away. So I</p> <p>9 would not say that is proof fairness under</p> <p>10 that definition.</p> <p>11 Q. And you've said -- we just talked</p> <p>12 about equal treatment of equals, and I believe</p> <p>13 you said that different buying tools and</p> <p>14 different exchanges are not necessarily equal;</p> <p>15 is that fair?</p> <p>16 A. That's correct, yes.</p> <p>17 Q. And because they're not equal, is it</p> <p>18 fair to say that different rules may be</p> <p>19 appropriate in certain circumstances?</p> <p>20 MR. CHANG: Objection. Form.</p> <p>21 A. It depends on what the rules are. So</p> <p>22 if the -- if we're talking about publisher</p> <p>23 ad-serving tools, the publisher is -- you</p> <p>24 know, should be served by those tools and we</p> |
| <p style="text-align: right;">Page 215</p> <p>1 So they're inherently not equal sources.</p> <p>2 There's different distributions that we're</p> <p>3 drawing from.</p> <p>4 Q. Does it -- would you say that it is</p> <p>5 fair to treat different exchanges with</p> <p>6 different floors?</p> <p>7 A. I think what is fair is for the</p> <p>8 publisher to have the option to price and set</p> <p>9 floors in a way that maximizes their</p> <p>10 interests. In this particular market, when we</p> <p>11 talk about fairness we usually think about a</p> <p>12 formal notion of envy, so is there an</p> <p>13 advertiser who envies the allocation that</p> <p>14 another advertiser got? And the publisher</p> <p>15 should be able to determine whether the</p> <p>16 allocation should go to Advertiser A or</p> <p>17 Advertiser B.</p> <p>18 So the usual -- I mean, one definition</p> <p>19 of fairness, formal definition is that there</p> <p>20 is no envy that's justified. That's a</p> <p>21 technical term that's used in the market</p> <p>22 design literature.</p> <p>23 So what would that mean? That would</p> <p>24 mean there is an advertiser who wished they</p> | <p style="text-align: right;">Page 217</p> <p>1 should be maximizing their interests. So a</p> <p>2 different rule that I'm fine with is a</p> <p>3 different way of setting reserve prices across</p> <p>4 sources of demand.</p> <p>5 If we're thinking about advertising</p> <p>6 exchanges as our market, then what I think is</p> <p>7 good for market design is ensuring that</p> <p>8 there's interoperability, that we are not</p> <p>9 discriminating between different sources of</p> <p>10 demand as the exchange. Now, the publisher</p> <p>11 may be willing to do that because it serves</p> <p>12 their interest, but the exchange is trying to</p> <p>13 maximize the gains from trade, right, trying</p> <p>14 to find matches.</p> <p>15 So discrimination, this is why, you</p> <p>16 know, our earlier discussion of financial</p> <p>17 markets, we have these nondiscrimination rules</p> <p>18 in those settings.</p> <p>19 BY MR. RYBNICEK:</p> <p>20 Q. So is it your opinion that an exchange</p> <p>21 should interoperate with all buying tools?</p> <p>22 MR. CHANG: Objection. Form.</p> <p>23 A. It depends. Is the exchange, are we</p> <p>24 in a perfectly competitive world, or does the</p>                                   |

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| <p style="text-align: right;">Page 218</p> <p>1 exchange have monopoly power and is using its</p> <p>2 decisions about interoperability to exclude</p> <p>3 competition?</p> <p>4 BY MR. RYBNICEK:</p> <p>5 Q. Let's take -- is an exchange that --</p> <p>6 in a situation in which there are a dozen</p> <p>7 exchanges, do each of those exchanges need to</p> <p>8 interoperate with all buying tools that are</p> <p>9 available?</p> <p>10 MR. CHANG: Objection. Form.</p> <p>11 A. As I understand your question, we're</p> <p>12 in a situation where we have a competitive</p> <p>13 exchange market where there are many, many</p> <p>14 options, 12 options across exchanges, and the</p> <p>15 decision to interoperate or not is not an</p> <p>16 exercise of the exclusion of competition. So</p> <p>17 in that world, I would say an exchange has the</p> <p>18 opportunity to decide who they want to</p> <p>19 interoperate with or not, if it's not</p> <p>20 excluding competition.</p> <p>21 BY MR. RYBNICEK:</p> <p>22 Q. And do you think that's probably --</p> <p>23 would that be equally true if there were eight</p> <p>24 exchanges?</p> | <p style="text-align: right;">Page 220</p> <p>1 A. Okay. As I understand your</p> <p>2 hypothetical, if we have indicia of</p> <p>3 competitive markets in the exchange market and</p> <p>4 the decision to interoperate or not is not</p> <p>5 being used to exclude competition, then I have</p> <p>6 no problem with that, giving the exchange the</p> <p>7 opportunity to make that decision.</p> <p>8 Q. But you have a different opinion if</p> <p>9 one -- if an exchange has monopoly power; is</p> <p>10 that fair?</p> <p>11 A. If there's an exchange that has</p> <p>12 monopoly power and is using the decision to</p> <p>13 interoperate to exclude competition, I have a</p> <p>14 problem with that, yes.</p> <p>15 Q. And how do you tell if excluding</p> <p>16 competition is on the merits or not?</p> <p>17 A. By reviewing the circumstances of the</p> <p>18 decision to interoperate or not.</p> <p>19 Q. Would you agree that a competitor</p> <p>20 exiting could be equally indicative of</p> <p>21 competition on the merits and anticompetitive</p> <p>22 exclusion?</p> <p>23 A. In the abstract, yes, I agree.</p> <p>24 Q. What would you look at to determine</p>        |
| <p style="text-align: right;">Page 219</p> <p>1 A. I don't think you can look at the</p> <p>2 number of exchanges to see how competitive the</p> <p>3 industry is. If you have eight exchanges and</p> <p>4 one exchange has 99 percent of the volume, I</p> <p>5 wouldn't call that competitive.</p> <p>6 Q. If no exchange had more than 50</p> <p>7 percent -- or if every exchange -- if no</p> <p>8 exchange had 50 percent or more and there were</p> <p>9 eight exchanges?</p> <p>10 A. I think these market share measures</p> <p>11 are, you know, indirect indicia of the</p> <p>12 presence of market power or not. So I would</p> <p>13 also want to look at direct evidence or how</p> <p>14 competitive the exchanges are before forming a</p> <p>15 view on that question.</p> <p>16 Q. Let me rephrase, then.</p> <p>17 If no exchange had 50 percent or more</p> <p>18 market share, there were eight exchanges and</p> <p>19 no exchange had monopoly power, would the</p> <p>20 exchanges need to interoperate with every</p> <p>21 buying tool?</p> <p>22 MR. CHANG: Objection. Form.</p> <p>23 BY MR. RYBNICEK:</p> <p>24 Q. Go ahead.</p>      | <p style="text-align: right;">Page 221</p> <p>1 whether exclusion was anticompetitive?</p> <p>2 A. I would look at the circumstances</p> <p>3 surrounding the exclusion, if they were</p> <p>4 outcompeted by a firm that had superior</p> <p>5 products versus they were unable to compete</p> <p>6 because of agreements or what have you, you</p> <p>7 would have to look at the circumstances of the</p> <p>8 exit.</p> <p>9 Q. But I'm talking about specifically in</p> <p>10 the context of not being given access to a</p> <p>11 buying tool. How would you know if that</p> <p>12 exclusion was the result of competition on the</p> <p>13 merits versus anticompetitive exclusion?</p> <p>14 A. If -- you know, if the exit were a</p> <p>15 consequence of, you know, an explicit</p> <p>16 agreement not to compete with the new entrant,</p> <p>17 that would be one example of anticompetitive</p> <p>18 conduct that caused the exit. So if I had</p> <p>19 evidence of that, that's one thing I could</p> <p>20 look at.</p> <p>21 Q. Sorry. I didn't quite understand</p> <p>22 that.</p> <p>23 When you say "an explicit agreement</p> <p>24 not to compete with a new entrant," an</p> |

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1 explicit agreement between whom?

2 A. Between incumbent firms. And we're

3 talking at an abstract level here still,

4 right? So if you have two firms that have

5 market power, there's a new entrant. Those

6 two firms sign an agreement saying "We don't

7 want to interoperate with the new entrant" and

8 then the new entrant exits, I would say that

9 is anticompetitive exit.

10 Q. We can put to the side horizontal

11 agreements. But in the situation of a bind --

12 whether or not -- going back to our example

13 we've been working with, with an exchange

14 interoperating with a buying tool --

15 A. Okay.

16 Q. -- how do you know whether the

17 exclusivity, let's put it that way, between

18 that buying tool and the exchange is

19 anticompetitive?

20 A. We'd have to look at the circumstances

21 of that exclusivity. Did it prevent the

22 buying tool from competing on the merits or

23 not?

24 Q. Sorry. I think in the example the --

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1 the other exchange wouldn't have access to the

2 buying tool that --

3 A. I think I might have lost the train

4 here. I'm really sorry. Could you --

5 Q. That's fine. It's getting later in

6 the day.

7 So we're talking about a scenario in

8 which an ad exchange has a -- sorry -- excuse

9 me -- a buying tool bids exclusively into an

10 ad exchange and that buying tool does not bid

11 into a competing ad exchange. The competing

12 ad exchange -- how do you know if the

13 competing ad exchange had harm due to

14 anticompetitive conduct versus competition on

15 the merits?

16 A. I would look at whether there was the

17 interest among folks who are using the buying

18 tool to maximize their objectives, say,

19 maximizing their ROI, and whether they had the

20 opportunity to express their willingness to

21 participate on the second exchange, that

22 exchange that existed in your example. And if

23 they were prevented from being able to

24 exercise that choice because of, say, an

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1 agreement between the buying tool and the

2 first exchange, that would be exclusionary

3 conduct that resulted in the second exchange

4 exiting.

5 Q. So it's your opinion that customer

6 preference, an opinion should be followed?

7 MR. CHANG: Objection. Form.

8 A. It's my -- you asked me about

9 competition on the merits.

10 BY MR. RYBNICEK:

11 Q. Uh-huh.

12 A. So my opinion is that competition on

13 the merits means that a customer has the

14 opportunity to connect with the exchange that

15 exists. And when they're prevented from doing

16 that, when they're excluded from doing that,

17 and that results in the competing exchange

18 exiting, that's not competition on the merits.

19 Q. But I guess what I'm struggling with

20 is the buying tool. In your opinion, it has

21 to listen to its customers. If the customers

22 say, "I want you to buy onto another

23 exchange," it is anticompetitive not to listen

24 to your customers; is that accurate?

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1 MR. CHANG: Objection. Form.

2 A. I am looking at these issues from a

3 market design perspective. So I would say

4 that the buying tool has got this interest of

5 the buyers, and so I would expect that the

6 buyers would want to be able to maximize their

7 gains from trade. And a way that buyers would

8 be able to maximize their gains from trade are

9 to be able to compete on multiple exchanges.

10 So the buying tools in the buying tool

11 market should be representing the interests of

12 buyers. And the fact that they did not do

13 that in your hypothetical is getting in the

14 way of efficient matches forming, and it's

15 preventing competition from having its

16 beneficial effects and leading to the exit of

17 this other index or the other exchange that

18 you have in your hypothetical.

19 Q. Could a -- could the management of the

20 buying tool have its own reasons for not

21 wanting to bid into that exchange that don't

22 have anything to do with competition such as

23 security or quality or other features that

24 override customer preference?

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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| <p style="text-align: right;">Page 226</p> <p>1 A. Yeah. I mean, in principle, yes,<br/>2 they're going to be balancing what the buying<br/>3 tools thinks its services are for its<br/>4 customers, the advertisers, the benefits<br/>5 versus the costs. So we would be weighing any<br/>6 perceived concern about negative effects of<br/>7 being on another exchange vis-a-vis safety, if<br/>8 you will, versus the positive effects of being<br/>9 able to find more matches and increase revenue<br/>10 -- the ROI of advertisers.<br/>11 Q. Are -- is line item capping something<br/>12 you analyzed in the context of congestion or<br/>13 the congestion market principle?<br/>14 A. Let me take a look at -- if I related<br/>15 line item capping to congestion precisely in<br/>16 my opening report here.<br/>17 (Witness reviews document.)<br/>18 The discussion of line item capping<br/>19 that I have in my opening report is in the<br/>20 section on header bidding. And my report<br/>21 talks about how line item capping was<br/>22 preventing efficient exchanges, efficient<br/>23 matches from forming through header bidding.<br/>24 It was -- as I say here, "Google would use the</p> | <p style="text-align: right;">Page 228</p> <p>1 [REDACTED]<br/>2 [REDACTED]<br/>3 [REDACTED]<br/>4 [REDACTED]<br/>5 [REDACTED]<br/>6 Q. Do you know if they rejected the<br/>7 request?<br/>8 A. Let me take a look here. In the<br/>9 specific instance of this e-mail<br/>10 correspondence?<br/>11 Q. Or in any other instance frankly.<br/>12 A. (Witness reviews document.)<br/>13 Let me take a look at what I wrote<br/>14 here so that -- I do know there were many<br/>15 requests to increase the line item caps, and<br/>16 some of them were rejected; some of them were<br/>17 accepted.<br/>18 [REDACTED]<br/>19 [REDACTED]<br/>20 [REDACTED]<br/>21 [REDACTED]<br/>22 [REDACTED]<br/>23 [REDACTED]<br/>24 [REDACTED]</p>                                                    |
| <p style="text-align: right;">Page 227</p> <p>1 ad server technology to impede the use of<br/>2 header bidding through line item caps," in<br/>3 page 149.<br/>4 So I see this as not congestion<br/>5 because there's no time dimension here.<br/>6 That's the kind of key principle behind<br/>7 congestion. There's no prioritization here.<br/>8 This is just I'm getting in the way of header<br/>9 bidding, publishers who want to find other<br/>10 sources of demand to maximize efficiency.<br/>11 BY MR. RYBNICEK:<br/>12 Q. Well, isn't -- didn't Google implement<br/>13 line item caps in order to ensure the system<br/>14 wasn't overburdened and deteriorated?<br/>15 A. Not -- that's not consistent with my<br/>16 review of the record.<br/>17 Q. What was the line item cap that Google<br/>18 imposed?<br/>19 A. I talk about a specific exchange with<br/>20 [REDACTED]<br/>21 [REDACTED]<br/>22 [REDACTED]<br/>23 [REDACTED]<br/>24 [REDACTED]</p>                                                                                                                                                                                                                                            | <p style="text-align: right;">Page 229</p> <p>1 [REDACTED]<br/>2 [REDACTED]<br/>3 [REDACTED]<br/>4 [REDACTED]<br/>5 Q. Can a handful of rejections of line<br/>6 item cap waivers affect competition?<br/>7 MR. CHANG: Objection. Form.<br/>8 [REDACTED]<br/>9 [REDACTED]<br/>10 [REDACTED]<br/>11 [REDACTED]<br/>12 [REDACTED]<br/>13 [REDACTED]<br/>14 [REDACTED]<br/>15 [REDACTED]<br/>16 BY MR. RYBNICEK:<br/>17 Q. Do you know what percentage of<br/>18 publishers were unable to use header bidding<br/>19 as they desired because of line item caps,<br/>20 Professor?<br/>21 A. The exact number of publishers that<br/>22 were unable to use header bidding because of<br/>23 line item caps? This is about how well you<br/>24 can effectively use header bidding line item</p> |

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1 caps, get in the way of setting value CPMs at  
 2 a very granular level. And, you know, one of  
 3 the documents in the record is the document  
 4 from Nitish Korula, who emphasizes it's  
 5 [REDACTED]  
 6 [REDACTED]  
 7 [REDACTED]. In fact, that's his  
 8 expression. I cite him in my reply report.  
 9  
 10 Q. But did you undertake an analysis of  
 11 the percentage of publishers who were affected  
 12 by line item caps?  
 13 A. As I said, that's a challenging, very  
 14 difficult analysis to do exactly because of  
 15 [REDACTED] that Google engineered  
 16 and Nitish Korula brought up.  
 17 I mean, the way I think about this is  
 18 we have markets that I've been involved in  
 19 designing where we have, you know, for various  
 20 reasons, restrictions on the number of things  
 21 you can rank.  
 22 So in New York City, when you apply to  
 23 high school you're only allowed to rank 12  
 24 choices. If you look at data and how many

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1 people are ranking 12 choices, is that  
 2 informative about how many people are affected  
 3 by that restriction? And it's not as simple  
 4 as looking at how many people are ranking 12  
 5 because there is a message that's conveyed by  
 6 the fact that there is a cap. There's a  
 7 signal there. This is the [REDACTED]  
 8 that Korula makes.  
 9 And we've seen in settings the city of  
 10 Chicago allowed people to rank four items one  
 11 year, and then they allowed people to rank six  
 12 items. If you had looked at the number of  
 13 people who were at the constraint at four to  
 14 forecast how many people would rank more than  
 15 four when you could rank six, then you would  
 16 have gotten a very inaccurate prediction. So  
 17 it's a very challenging exercise to do given  
 18 that there's a constraint and there's this  
 19 anchoring involved. So I did not do a  
 20 quantitative analysis of that.  
 21 Q. Thank you.  
 22 Is it fair to say that publishers who  
 23 were only halfway to the line item cap -- only  
 24 used half the number of line item cap as

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1 available, they probably were not affected by  
 2 the line item cap?  
 3 A. I mean, there is a microlevel answer  
 4 to your question, and then there's a  
 5 macrolevel answer to your question. So on the  
 6 micro side, if I am so far from the constraint  
 7 you would expect that if the constraint were a  
 8 little bit higher, the anchoring dimensions  
 9 would be second order. So I would agree with  
 10 that, although there are exceptions.  
 11 And if you look at the Chicago example  
 12 that I just described, you would see that  
 13 there is a pretty large-scale behavioral  
 14 response in the number of things people rank  
 15 when they changed it from four to six  
 16 throughout. So that's on the micro side.  
 17 On the macro side, if line item caps  
 18 are being used to make header bidding a less  
 19 effective product, a less effective  
 20 innovation, then a publisher who's still not  
 21 at the cap is affected by Google's actions to  
 22 try to achieve, as they describe it, the Holy  
 23 Grail of killing header bidding.  
 24 Q. Do you think Google should have made

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1 it easier for header bidding to operate?  
 2 A. If we focus on publisher ad-serving  
 3 tools, they should have the incentive to  
 4 maximize the interest of publishers. And  
 5 header bidding was an innovation that came  
 6 outside of Google in reaction to Google's  
 7 conduct in dynamic allocation. As Google's  
 8 own employees state, header bidding was  
 9 created as a response to dynamic allocation.  
 10 So we think about the incentives here.  
 11 Publisher ad-serving tools should want to do  
 12 what they can to maximize the interest of  
 13 publishers and publishers want header bidding.  
 14 Then there's no reason for Google to take  
 15 actions to try to make header bidding less  
 16 effective.  
 17 Q. But you agree that header bidding is a  
 18 competitor of Google's, correct?  
 19 A. It's an alternative to Google's  
 20 products, so, yeah, it's competing with  
 21 Google.  
 22 Q. So do we typically in markets want  
 23 competitors to help each other?  
 24 MR. CHANG: Objection. Form.



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1 A. This comes back to are we in a  
2 perfectly competitive world where there's  
3 competition on the merits, or are we in a  
4 world where a dominant firm is taking actions  
5 to exclude rivals? And I think in that case  
6 of Google's conduct vis-a-vis header bidding,  
7 we're in the latter case because, as you know,  
8 Chris LaSala says in [REDACTED]  
9 [REDACTED]  
10 [REDACTED]  
11 [REDACTED]  
12 [REDACTED]  
13 [REDACTED]  
14 [REDACTED]  
15 [REDACTED]  
16 [REDACTED]  
17 [REDACTED]  
18 [REDACTED]  
19 [REDACTED]  
20 [REDACTED]  
21 [REDACTED]  
22 [REDACTED]  
23 [REDACTED]  
24 [REDACTED]

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1 consistent with a concerted effort to try to  
2 use whatever means the dominant firm could  
3 have at its disposal to not compete on the  
4 merits.  
5 Competition on the merits in this case  
6 would be there is a new way to transact, so we  
7 should cut our price to make our products more  
8 attractive to participants, or we should offer  
9 new services. And the examples I just gave  
10 are not examples of competition on the merits.  
11 Q. You just said we should either cut  
12 price or offer new services. Is open bidding  
13 a new service that Google offered in the wake  
14 of header bidding?  
15 A. Open bidding is a new alternative.  
16 That's correct, yes.  
17 Q. So that is competition on the merits  
18 by Google in reaction to header bidding,  
19 correct?  
20 A. I wouldn't say it's that simple  
21 because open bidding had an additional tax.  
22 In fact, I mean, we can just look at Google's  
23 own documents on this where Google concedes in  
24 [REDACTED]

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1 [REDACTED]  
2 [REDACTED]  
3 [REDACTED]  
4 [REDACTED] and it's part of  
5 this consistent pattern of behavior of Google  
6 to try to block header bidding.  
7 Q. So you agree header bidding is an  
8 innovation that Google -- or excuse me.  
9 Strike that.  
10 You agree that open bidding is a new  
11 product that Google created?  
12 A. Yes.  
13 Q. And it did that in the wake of header  
14 bidding; is that correct?  
15 A. Yes. It's an alternative, yes.  
16 Q. But what you don't like about the  
17 market design is that Google charged for that  
18 new product; is that accurate?  
19 A. That's one of the things that I don't  
20 like about exchange bidding, that it was  
21 created as an alternative to eliminate what  
22 publishers wanted, which is, you know, a way  
23 to transact their inventory without having to  
24 pay that extra fee without being reliant on

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1 Google's tools.  
2 And exchange bidding's extra fee,  
3 because Google is a dominant firm, is  
4 preventing the competition with header  
5 bidding.  
6 Q. And when we say "exchange bidding" and  
7 "open bidding," you know that those are the  
8 same thing, right?  
9 A. Yeah, yeah.  
10 Q. Okay.  
11 A. Sorry if I changed words. Yeah.  
12 Q. No, that's fine.  
13 I know we've been going just over an  
14 hour. We can take a break in just one second.  
15 I was asking you questions about UPR,  
16 and we got diverted on this lovely tangent.  
17 The last question I wanted to talk  
18 about on UPR is why isn't UPR -- why doesn't  
19 UPR satisfy your market principle of strategy  
20 proofing?  
21 A. Strategy proofing has a very explicit  
22 definition, which is, in a mechanism, you want  
23 to make it a dominant strategy to reveal your  
24 type. So in the context of an auction, the

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
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| <p style="text-align: right;">Page 238</p> <p>1 plain vanilla second-price auction is a</p> <p>2 strategy-proof auction because if your type is</p> <p>3 your value, it's a dominant strategy, meaning</p> <p>4 no matter what anyone else submits as their</p> <p>5 bid, you can do no better than bidding your</p> <p>6 value.</p> <p>7 UPR has nothing to do with strategy</p> <p>8 proofness.</p> <p>9 Q. But doesn't having different floors</p> <p>10 lead to strategic bidding behavior?</p> <p>11 A. If I have the plain vanilla model</p> <p>12 where I have -- you know, UPR was used when</p> <p>13 the first-price format was put into place. So</p> <p>14 the -- you know, we've talked about the first</p> <p>15 week of my undergraduate class in market</p> <p>16 design.</p> <p>17 In the second week of the</p> <p>18 undergraduate class in market design, I</p> <p>19 explain why the first-price auction is not a</p> <p>20 strategy-proof mechanism. It's not a</p> <p>21 strategy-proof mechanism because if you bid</p> <p>22 honestly and you win, your profit is zero</p> <p>23 because you pay what you bid. So there's a</p> <p>24 very robust force as a bidder in a first-price</p>            | <p style="text-align: right;">Page 240</p> <p>1 be satisfied in practice.</p> <p>2 So by restricting the publisher from</p> <p>3 being able to set different reserve prices,</p> <p>4 you've restricted the publisher from being</p> <p>5 able to optimize, and you're getting in the</p> <p>6 way of that optimization decision. So I</p> <p>7 wouldn't say that that is strategy proof.</p> <p>8 I mean, usually, when we take about</p> <p>9 strategy proofness, we're talking about the</p> <p>10 bidders going into the auction. Because what</p> <p>11 is the strategic problem there? It's the</p> <p>12 problem of bidders playing a strategic,</p> <p>13 multiperson decision problem against other</p> <p>14 bidders. Should I outbid you? Should you</p> <p>15 outbid me? So on and so forth.</p> <p>16 And when a publisher is setting its</p> <p>17 reserve price, that's what we would say in</p> <p>18 economics is a decision problem, so there's no</p> <p>19 strategic dimension to the decision problem.</p> <p>20 I just have an optimization.</p> <p>21 So my optimization is maximizing</p> <p>22 something, right? And so the way I would</p> <p>23 think about UPR is I have a maximization</p> <p>24 problem where I have one control variable,</p> |
| <p style="text-align: right;">Page 239</p> <p>1 auction that you do not want to bid honestly.</p> <p>2 So we're already in a world where we</p> <p>3 have a first-price auction which is not</p> <p>4 strategy proof. And having different reserve</p> <p>5 prices is just an extra lever there, but we're</p> <p>6 so far from a strategy-proof world once we're</p> <p>7 in a first-price auction that I would not say</p> <p>8 it's strategy proof either way. It's a</p> <p>9 first-price format, so we're already not</p> <p>10 strategy proof.</p> <p>11 Q. Sure. From -- I get that from the</p> <p>12 advertiser's side.</p> <p>13 What about from the publisher's</p> <p>14 side?</p> <p>15 A. So the publisher's choice in a</p> <p>16 first-price format is setting the reserve</p> <p>17 price, right, so that's their decision</p> <p>18 variable. And they want to do that to</p> <p>19 maximize their revenue. And it's only under</p> <p>20 very, very special assumptions on the</p> <p>21 distribution of demand across different</p> <p>22 venues, where setting the same exact reserve</p> <p>23 price would be the optimal decision. Those</p> <p>24 assum- -- those assumptions are very likely to</p> | <p style="text-align: right;">Page 241</p> <p>1 which is a single uniform price that's used</p> <p>2 across different venues, versus a maximization</p> <p>3 problem, where I have multiple control</p> <p>4 variables that are used for setting reserve</p> <p>5 prices across different venues.</p> <p>6 And what UPR is imposing is a</p> <p>7 constraint on the variables I can optimize</p> <p>8 over because I have to make that the same</p> <p>9 across the different venues.</p> <p>10 Q. I think -- so is your -- it's your</p> <p>11 opinion that UPR -- or strike that.</p> <p>12 Is it your opinion that setting floors</p> <p>13 is not a strategic decision by publishers?</p> <p>14 MR. CHANG: Objection. Form.</p> <p>15 A. What we need to be very precise about</p> <p>16 is what we mean by "strategic decision." So</p> <p>17 when I talk about a strategic decision, I'm</p> <p>18 thinking about using the tools of game theory.</p> <p>19 And so game theory is also known as</p> <p>20 multiperson decision theory where your</p> <p>21 strategies depend on the behaviors of other</p> <p>22 players in the game.</p> <p>23 So on the advertiser's side, how much</p> <p>24 I should shade my bid in a first-price auction</p>                     |

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| <p style="text-align: right;">Page 242</p> <p>1 will depend on how much I think my opponents</p> <p>2 are shading their bid in a first-price</p> <p>3 auction.</p> <p>4 When you're thinking about the</p> <p>5 seller's problem, the seller's problem, as in,</p> <p>6 say, Myerson's "Optimal Auction" paper, is</p> <p>7 typically seen as a -- you know, we're in the</p> <p>8 idealized models here, so I should emphasize</p> <p>9 that, but it's typically seen as just an</p> <p>10 optimization problem.</p> <p>11 I have the opportunity to set</p> <p>12 different reserve prices. Those can be</p> <p>13 different for different bidders. And it's not</p> <p>14 a multiperson problem because if there's a</p> <p>15 single seller setting the reserve price in</p> <p>16 maximizing a single function. So that's the</p> <p>17 technical distinction that I'm trying to draw</p> <p>18 here.</p> <p>19 Now, if you want to use the word</p> <p>20 "strategic" as a -- you know, maybe the way</p> <p>21 that a noneconomist would use the word</p> <p>22 "strategic," if a bidding -- you know, if</p> <p>23 you're a publisher and you're thinking about</p> <p>24 how should I set my reserve price, you likely</p> | <p style="text-align: right;">Page 244</p> <p>1 And so Google is trying to eliminate that high</p> <p>2 AdX floor by imposing that floors have to be</p> <p>3 the same across different sources of demand.</p> <p>4 So it's overriding publisher choice on how</p> <p>5 they want to set inventory.</p> <p>6 It's -- for instance, if different</p> <p>7 sources of demand have different attributes,</p> <p>8 we're concerned about sources of demand</p> <p>9 because we are "The New York Times," and we</p> <p>10 don't want to have advertisements of, you</p> <p>11 know, fake Rolex watches being shown to "New</p> <p>12 York Times" subscribers. I have the -- I</p> <p>13 don't have the ability to use my reserve price</p> <p>14 to distinguish against sources of demand that</p> <p>15 may be lower quality if I'm required to</p> <p>16 impose -- it's the same across all sources.</p> <p>17 Q. But you can choose just not to</p> <p>18 interoperate with that demand source, right?</p> <p>19 A. That would be an extreme version of</p> <p>20 that.</p> <p>21 So you could think of that as I set my</p> <p>22 reserve to infinity. So UPR, you could</p> <p>23 imagine as reserve prices are the same for all</p> <p>24 sources of demand except for places where it's</p> |
| <p style="text-align: right;">Page 243</p> <p>1 have a strategy team thinking about what's the</p> <p>2 best way to optimize my goals with my</p> <p>3 different reserve prices, and there coming up</p> <p>4 with your -- your strategy. But the way I</p> <p>5 would think about that is they're maximizing</p> <p>6 some objective function for that seller MR.</p> <p>7 RYBNICEK:</p> <p>8 Q. But even after UPR, publishers could</p> <p>9 accomplish the goals you outline, are you --</p> <p>10 are what price floors are used for, such as</p> <p>11 signaling the quality of the advertisement; is</p> <p>12 that fair?</p> <p>13 A. Not -- not as well. I wouldn't agree</p> <p>14 with that statement.</p> <p>15 Q. Well, I mean, they could still set</p> <p>16 high floors, right?</p> <p>17 A. You're required to do that across all</p> <p>18 exchanges.</p> <p>19 So in the record, what we have, as I</p> <p>20 talk about in my report, is consistent</p> <p>21 evidence that Google is requiring the floors</p> <p>22 to be uniform to explicitly take AdX floors</p> <p>23 and make them lower, because historically, in</p> <p>24 many instances, the AdX floors were very high.</p>                           | <p style="text-align: right;">Page 245</p> <p>1 infinity. Okay. The previous regime, which</p> <p>2 allowed for publisher choice, is allowing much</p> <p>3 more flexibility than those two possible</p> <p>4 outcomes and is, therefore, getting in the way</p> <p>5 of publishers realizing their goals.</p> <p>6 Q. So if a publisher doesn't want</p> <p>7 offensive ads, in what scenario would they</p> <p>8 want it at a high reserve price?</p> <p>9 For example, if a publisher doesn't</p> <p>10 want political propaGansda, is your point</p> <p>11 that, well, maybe they'll take it at a certain</p> <p>12 price?</p> <p>13 A. My point is publisher should have the</p> <p>14 opportunity to make that decision for</p> <p>15 themselves and weigh the benefits of having</p> <p>16 negative political ads on their website</p> <p>17 relative to the, you know, costs of that on</p> <p>18 viewers and their reputation and their own</p> <p>19 interests as a publisher.</p> <p>20 And if the ad tech tools for</p> <p>21 publishers are truly reflecting the interest</p> <p>22 of publishers and are not trying to steer</p> <p>23 demand to AdX and unwind the high AdX floors,</p> <p>24 as Google documents describe, I see no reason</p>                                 |

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| <p style="text-align: right;">Page 246</p> <p>1 to take away that choice for publishers.</p> <p>2 MR. RYBNICEK: I think it's a</p> <p>3 good place for a break.</p> <p>4 THE VIDEOGRAPHER: The time is</p> <p>5 3:39. We're off the record.</p> <p>6</p> <p>7 (Recess taken from 3:39 p.m.</p> <p>8 to 3:52 p.m.)</p> <p>9</p> <p>10 THE VIDEOGRAPHER: We are back</p> <p>11 on the record. The time is 3:52.</p> <p>12 BY MR. RYBNICEK:</p> <p>13 Q. I want to turn to transparency.</p> <p>14 Transparency is a market design</p> <p>15 principle that you implemented as part of your</p> <p>16 analysis; is that right?</p> <p>17 A. That's correct, yes.</p> <p>18 Q. And can you explain how transparency</p> <p>19 applies in the context of market design?</p> <p>20 A. Let me start by looking at the precise</p> <p>21 definition of "transparency" in my report.</p> <p>22 (Witness reviews document.)</p> <p>23 So I talk about transparency in</p> <p>24 Paragraph 40, where I say "Markets become safe</p>                                                                                                                                                                                                                                                                                                                 | <p style="text-align: right;">Page 248</p> <p>1 situation where my first choice is combat arms</p> <p>2 for three years, my second choice is cyber for</p> <p>3 three years, and my third choice is combat</p> <p>4 arms for five years. So what's important</p> <p>5 about that example is it's not like combat</p> <p>6 arms dominates everything else, so I will do</p> <p>7 it for three years, but then if I can't get it</p> <p>8 for three, I'll do it for five. There has to</p> <p>9 be something in between.</p> <p>10 So if you look at the "Army Times" --</p> <p>11 that's the newspaper that the Army puts. They</p> <p>12 have a website as well -- there is quotes from</p> <p>13 cadets saying, How do they expect us to behave</p> <p>14 in such a system where it's not in our</p> <p>15 interest to reveal our information honestly?</p> <p>16 They haven't described the rules of the</p> <p>17 process. Moreover, we are cadets who might be</p> <p>18 in combat situations, and we have to trust</p> <p>19 each other, and here is a system where they</p> <p>20 are encouraging us to try to sabotage each</p> <p>21 other in the ROTC system.</p> <p>22 Actually, the amazing thing about that</p> <p>23 system before I got involved is they had some</p> <p>24 concerns about diversity of the ROTC course</p>             |
| <p style="text-align: right;">Page 247</p> <p>1 when participants have transparency about</p> <p>2 their rules of the market." And by that, I</p> <p>3 mean participants understand how the market</p> <p>4 clears, you know, how demand is matched to</p> <p>5 supply. So in the market design toolbox, we</p> <p>6 emphasize transparency. Let me give you an</p> <p>7 example from my own research.</p> <p>8 When I was involved in setting up the</p> <p>9 West Point cadet branch assignment system, the</p> <p>10 reason I was asked to be involved as part of a</p> <p>11 team was the prior system did not encourage</p> <p>12 participants to behave honestly. So when you</p> <p>13 were asked to rank branches, like combat arms,</p> <p>14 you were not allowed to express whether you</p> <p>15 like combat arms with the extended service</p> <p>16 commitment or with the short-run commitment.</p> <p>17 The participants, the OEMA office, the</p> <p>18 Office of Economic and Manpower Analysis at</p> <p>19 West Point, had not interacted with market</p> <p>20 design scholars at that time, and they came up</p> <p>21 with their own protocol.</p> <p>22 So many of the participants in that</p> <p>23 system were unclear how to participate, what</p> <p>24 would be the right strategy, especially in the</p> | <p style="text-align: right;">Page 249</p> <p>1 and their job placement. And they had a</p> <p>2 set-aside for positions for cadets whose</p> <p>3 scores were in the bottom half of the</p> <p>4 distribution, and because the design was</p> <p>5 poorly constructed, cadets had the opportunity</p> <p>6 to purposely degrade their score so as to get</p> <p>7 a better match, what they call tanking. So if</p> <p>8 you go online, on the web, you can see endless</p> <p>9 discussion about tanking, and maybe I should</p> <p>10 purposefully fail the exam because it's going</p> <p>11 to allow me to get one of these slots that are</p> <p>12 reserved for low-performing students.</p> <p>13 What's very difficult about that is to</p> <p>14 be able to react to situations where you</p> <p>15 really need to understand the market rules,</p> <p>16 you have to form an assessment about what the</p> <p>17 other cadets are going to do. Or in our</p> <p>18 example here, in the auctions, if you're</p> <p>19 bidding against other advertisers, you have to</p> <p>20 think very carefully about what are the other</p> <p>21 bidders going to do, and you want to have the</p> <p>22 most amount of information to be able to</p> <p>23 figure out what your optimal strategy is.</p> <p>24 So what the military now does in</p> |

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| <p style="text-align: right;">Page 250</p> <p>1 furtherance of transparency is they have a<br/> 2 series of videos describing exactly how the<br/> 3 mechanism works for cadets. They even do a<br/> 4 simulation for cadets, actually more than one<br/> 5 simulation. In your senior year at West<br/> 6 Point, you go through a hypothetical<br/> 7 simulation of a cadet branch match-assignment<br/> 8 process to make sure people understand the<br/> 9 rules of the market, so they do that together<br/> 10 with informational videos.<br/> 11 And then finally, at the conclusion of<br/> 12 the process, they report information that<br/> 13 allows participants to verify that the rules<br/> 14 were implemented as advertised. So what they<br/> 15 do there and what many transparent market<br/> 16 clearinghouses do is provide some summary<br/> 17 information that does not violate the privacy<br/> 18 of the participants but amounts to things like<br/> 19 cutoffs.<br/> 20 What did you need to get assigned<br/> 21 combat arms? You needed to have an order of<br/> 22 merit list score, say, of 85th percentile. So<br/> 23 as a participant, you can verify ex post. The<br/> 24 reason I didn't get into combat arms is my</p> | <p style="text-align: right;">Page 252</p> <p>1 when we approach these issues from the market<br/> 2 design lens, we have different objectives. So<br/> 3 transparency of an economic system is valuable<br/> 4 in and of itself in, my view, so that would be<br/> 5 an objective as well. But transparency is<br/> 6 also valuable because it furthers the<br/> 7 possibility that market participants are going<br/> 8 to be able to understand and best respond to<br/> 9 the rules.<br/> 10 So back to our definition of what is a<br/> 11 competitive market, there's goal-seeking<br/> 12 agents on both sides of the market who are<br/> 13 able to optimize their objectives, and, you<br/> 14 know, the price is what's going to clear that<br/> 15 market. So when you have opaque information<br/> 16 about how the market actually clears, it gets<br/> 17 very difficult to optimize with respect to<br/> 18 those objectives and lead to competitive<br/> 19 outcomes.<br/> 20 Q. But is it necessarily the case that a<br/> 21 market where there is not maximum<br/> 22 transparency, the market is -- lacks<br/> 23 competition?<br/> 24 MR. CHANG: Objection. Form.</p>                         |
| <p style="text-align: right;">Page 251</p> <p>1 score was less than 85. And so that's, you<br/> 2 know, the example from the military project<br/> 3 that I've been involved in.<br/> 4 But the same kind of ideas, I think,<br/> 5 apply to the issues in this -- in the markets<br/> 6 that we're analyzing here.<br/> 7 So how do I apply transparency, the<br/> 8 market design principle of transparency here?<br/> 9 What I would like to see is the bidders have<br/> 10 full knowledge of what the auction rules are.<br/> 11 Is it a true second-price auction, or is it a<br/> 12 30-second price auction? We have full<br/> 13 auditability. Can I verify ex post why was it<br/> 14 that I did not win this impression? Do I have<br/> 15 enough data that's provided to me to figure<br/> 16 that out?<br/> 17 BY MR. RYBNICEK:<br/> 18 Q. Thank you for that overview.<br/> 19 I think you said something along the<br/> 20 lines of what I would like to see, and then<br/> 21 explained what you would like to see in the ad<br/> 22 tech market. Is what you would like to see<br/> 23 the benchmark for, what is competitive?<br/> 24 A. Well, you know, as we talked about,</p>                                                           | <p style="text-align: right;">Page 253</p> <p>1 A. The answer to that question depends on<br/> 2 what the definition of "maximum transparency"<br/> 3 is. So as I described in the example of the<br/> 4 West Point job assignment, they don't reveal<br/> 5 afterwards, after the process is completed,<br/> 6 what every cadet's score is. That's<br/> 7 considered private information.<br/> 8 If I'm a cadet at West Point, I don't<br/> 9 necessarily want to have my friend know what<br/> 10 my score was on the physical tasks, how many<br/> 11 pull-ups I could do or how many pounds I can<br/> 12 bench press. But what they do reveal is<br/> 13 information that's sufficient to verify that<br/> 14 the allocation was computed as advertised. So<br/> 15 I think that's very important, to get to<br/> 16 efficient outcomes, that you have sufficient<br/> 17 information to verify that the protocol, the<br/> 18 market-clearing mechanism was implemented as<br/> 19 intended.<br/> 20 BY MR. RYBNICEK:<br/> 21 Q. But that doesn't require every bid<br/> 22 optimization to be disclosed; is that fair?<br/> 23 MR. CHANG: Objection. Form.<br/> 24 A. Bid optimizations that are taking</p> |



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| <p style="text-align: right;">Page 254</p> <p>1 place interfere with choices that bidders make</p> <p>2 in an auction. So if it turns out that I bid</p> <p>3 a certain amount into an auction and my value</p> <p>4 for the item is, let's say, ten and it turns</p> <p>5 out that I did not win that auction and</p> <p>6 someone else won that auction who has a lower</p> <p>7 value than me but was able to win that auction</p> <p>8 because of a so-called bid optimization --</p> <p>9 maybe the system inflated their bid to allow</p> <p>10 them to win -- then I would be very confused</p> <p>11 about how the auction is working, and I would</p> <p>12 have concerns that the rules are not as</p> <p>13 advertised, and it would be very challenging</p> <p>14 for me to figure out what is my optimal</p> <p>15 response in such a system.</p> <p>16 BY MR. RYBNICEK:</p> <p>17 Q. Are there some bid optimizations that</p> <p>18 don't need to be disclosed?</p> <p>19 A. In an ideal market design, if there is</p> <p>20 a bid optimization that is done by an</p> <p>21 advertiser buying tool, I think it's best if</p> <p>22 the participants in the advertiser buy side of</p> <p>23 the market have the opportunity to evaluate</p> <p>24 whether or not they are actually partaking in</p> | <p style="text-align: right;">Page 256</p> <p>1 particular auction. Should I shade my bid</p> <p>2 by 50 percent or by 20 percent?</p> <p>3 If Google is putting Bernanke and</p> <p>4 inflating and deflating bids at the same time</p> <p>5 it's adjusting the take rate, at the same time</p> <p>6 it's throttling, you know, it's periodically</p> <p>7 making it harder for folks to detect that is</p> <p>8 occurring, it's not disclosing to bidders that</p> <p>9 we're doing Bernanke, it's very challenging</p> <p>10 for a bidder, even if they are able to do</p> <p>11 controlled experiments, to be able to</p> <p>12 attribute their performance and display</p> <p>13 advertising, in purchasing of advertising to</p> <p>14 the choices that they make because some of</p> <p>15 those choices are a consequence of things that</p> <p>16 they're completely unaware of.</p> <p>17 Q. But they can evaluate their</p> <p>18 performance through Google Ads versus other</p> <p>19 buying tools, correct?</p> <p>20 A. They -- you know, I think we've talked</p> <p>21 about this. You know, as a matter of</p> <p>22 arithmetic, you can figure out this is what I</p> <p>23 was charged. These are the slots that I got.</p> <p>24 But what you don't know is why. Why was I</p>   |
| <p style="text-align: right;">Page 255</p> <p>1 the bid optimization program and make that</p> <p>2 choice for themselves.</p> <p>3 So bid optimization, if it truly is</p> <p>4 changing the bids that the agent submits into</p> <p>5 the system, should be disclosed to</p> <p>6 participants, the workings of how that is</p> <p>7 taking place. So, you know, the -- we want to</p> <p>8 make sure that the agents in the economic</p> <p>9 system have adequate information to figure out</p> <p>10 whether they like the optimization or not,</p> <p>11 whether it's helping them achieve their goals</p> <p>12 or not, whether it truly is an improvement for</p> <p>13 them or not.</p> <p>14 Q. And advertisers can't do that based on</p> <p>15 an assessment of whether they're satisfied</p> <p>16 with the return on investment or not?</p> <p>17 A. I don't believe they can do that</p> <p>18 because the mapping between the decisions they</p> <p>19 make and what return they get on their</p> <p>20 investment is compromised by optimizations or</p> <p>21 other conducts, let's call them, that are</p> <p>22 layered on top of each other in a way that</p> <p>23 makes it intransparent for them to figure out</p> <p>24 what's my best course of action in this</p>                         | <p style="text-align: right;">Page 257</p> <p>1 assigned this slot? Why was I charged this</p> <p>2 amount? Was there a debt? Was there a</p> <p>3 Bernanke pool here? How do I best respond to</p> <p>4 that? How do I figure out what's in my</p> <p>5 interest as a bidder? The buy-side tool is</p> <p>6 supposedly helping me, as a buyer, purchase</p> <p>7 advertising. Transparency in those rules and</p> <p>8 these optimizations furthers the interests of</p> <p>9 the buyers.</p> <p>10 Q. But if an advertiser doesn't like the</p> <p>11 return on investment its receiving from Google</p> <p>12 Ads, it could switch to an alternative buying</p> <p>13 tool where it may perceive it has a higher</p> <p>14 return on investment; is that fair?</p> <p>15 A. They would have that choice to switch,</p> <p>16 but it's a bit of what I call a Hobson's</p> <p>17 choice because Google is so dominant that it's</p> <p>18 not really a true choice for them because they</p> <p>19 would be sacrificing a lot.</p> <p>20 Now, of course, the advertiser can</p> <p>21 judge that trade-off, whether it's worth it or</p> <p>22 not. But ideally, they would be able to</p> <p>23 understand why is it that they got the</p> <p>24 inventory that they got rather than just, you</p> |



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| <p style="text-align: right;">Page 258</p> <p>1 know, an abstract here is the number of people<br/> 2 who clicked on your ad, or here's how much<br/> 3 we're charging. And when you're designing a<br/> 4 market, you know, to make sure people have<br/> 5 faith in the institution that you set up, you<br/> 6 want to ensure that people have an<br/> 7 understanding or the ability to understand<br/> 8 what -- you know, is what's dictating the<br/> 9 terms of trade.</p> <p>10 Q. To the extent an advertiser is not<br/> 11 receiving a satisfactory return on investments<br/> 12 through Google Ads and determines it can get a<br/> 13 higher return on investments through another<br/> 14 buying tool, what is preventing it from<br/> 15 switching?</p> <p>16 A. In that world, if it's a simple<br/> 17 comparison of, in Google, I'm getting a<br/> 18 hundred bucks, and the other tool, I'm getting<br/> 19 200 bucks, then they are able to switch and<br/> 20 make that decision.</p> <p>21 Q. Is it possible to be too<br/> 22 transparent?</p> <p>23 A. At this level of abstraction<br/> 24 certainly, it's possible that there can be too</p>                                                            | <p style="text-align: right;">Page 260</p> <p>1 with all of their decision aids and videos<br/> 2 about how the process works, they reveal<br/> 3 enough to make sure people have trust in the<br/> 4 process and can verify that what they got is<br/> 5 according to the market-clearing rules.</p> <p>6 But, you know, some information -- to<br/> 7 your question, is it too transparent, they<br/> 8 don't reveal everyone's OML score in the<br/> 9 system.</p> <p>10 I can give you another example too.<br/> 11 It's a very topical example.</p> <p>12 Right now in New York City, when you<br/> 13 apply to high school, there is a concern that<br/> 14 parents have that they want to know their<br/> 15 lottery number. Okay? So the reason why this<br/> 16 came about is that, when you set up your<br/> 17 account to rank schools in New York City, your<br/> 18 account is associated with a hash code. Okay?<br/> 19 And a parent, who happens to be a computer<br/> 20 science professor at Rutgers, figured out that<br/> 21 that hash code is a mapping to your lottery<br/> 22 number.</p> <p>23 Okay? So just one person figured this<br/> 24 out, and they then broadcast a message to all</p>                                                                |
| <p style="text-align: right;">Page 259</p> <p>1 much transparency.</p> <p>2 So if we go back to my example of the<br/> 3 West Point cadet branch assignment process,<br/> 4 one potential concern is the information<br/> 5 that's revealed during that process will be<br/> 6 used for reasons other than that process. So<br/> 7 if it becomes common knowledge, if everyone in<br/> 8 the system knows what your order of merit list<br/> 9 is, what your score is -- if I know that<br/> 10 you're not actually that strong -- maybe<br/> 11 you're really good in history -- but the<br/> 12 reason why you're OML score is high is not<br/> 13 because you can't do many push-ups, that could<br/> 14 affect what happens to you outside of the<br/> 15 initial allocation.</p> <p>16 So you could get sent to combat arms<br/> 17 because your overall OML score is high, but<br/> 18 then you end up going to combat arms, and<br/> 19 everyone would see, ah, this guy is actually a<br/> 20 wimp, and that would affect the quality of<br/> 21 your assignment. So for that reason, they<br/> 22 don't reveal that private information to<br/> 23 market participants.</p> <p>24 They reveal just enough -- you know,</p> | <p style="text-align: right;">Page 261</p> <p>1 the participants saying, Hey, by the way, this<br/> 2 hash code is related to your lottery number,<br/> 3 so you should -- therefore, if you got a bad<br/> 4 lottery number, here's how you dehash that<br/> 5 hash code. You should cancel your application<br/> 6 and create a new profile and reapply. You'll<br/> 7 get a new draw from the lottery number. And<br/> 8 so that would be a situation where maybe you<br/> 9 don't want to give parents the hash code.</p> <p>10 New York City did not go in that<br/> 11 direction actually. What they're doing this<br/> 12 fall -- it's just about to start -- is they<br/> 13 are giving families their actual, true lottery<br/> 14 number, and they're educating the families<br/> 15 that knowing your lottery number should not<br/> 16 influence what schools you apply to because<br/> 17 the New York City high school assignment<br/> 18 system is a strategy-proof system. So it<br/> 19 doesn't matter what anyone else is ranking,<br/> 20 you can do no better than ranking your schools<br/> 21 honestly.</p> <p>22 So there are ways to manage<br/> 23 transparency, but I've given you some examples<br/> 24 where going to full transparency, even getting</p> |

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| <p style="text-align: right;">Page 262</p> <p>1 your exact lottery number can be good, or</p> <p>2 maybe you don't want to have the transparency</p> <p>3 of your scores because they're going to use</p> <p>4 that to give you a bad assignment later or</p> <p>5 something that's unrelated to the assignment.</p> <p>6 Q. Is it fair to say it's a fact-specific</p> <p>7 exercise?</p> <p>8 A. Yes. Yes.</p> <p>9 Q. Okay. And we talked at the very</p> <p>10 beginning how you're relying on Professor Gans</p> <p>11 for market definition, right?</p> <p>12 A. That's correct.</p> <p>13 Q. And he defines that Google Ads is in a</p> <p>14 small advertiser buying tool market; is that</p> <p>15 right?</p> <p>16 A. That's correct.</p> <p>17 Q. And does he characterize advertisers</p> <p>18 using small advertiser buying tools as less</p> <p>19 sophisticated and needing less or limited</p> <p>20 functionality?</p> <p>21 A. In his report, I think he talks about</p> <p>22 minimum spend requirements that apply to large</p> <p>23 advertiser buying tools. So advertisers who</p> <p>24 don't have as much ability to spend, if that's</p>                                               | <p style="text-align: right;">Page 264</p> <p>1 that use small advertising buying tools in</p> <p>2 Professor Gans' candidate market don't have</p> <p>3 the budget to afford a large advertiser buying</p> <p>4 tool?</p> <p>5 A. It's a decision --</p> <p>6 MR. CHANG: Objection. Form.</p> <p>7 THE WITNESS: Sorry.</p> <p>8 A. The decision to use, you know, a small</p> <p>9 advertiser buying tool or a large advertiser</p> <p>10 buying tool depends on many factors. One of</p> <p>11 those factors is whether you think you will</p> <p>12 hit the minimum spend requirement. And to hit</p> <p>13 the minimum spend requirement, an advertiser</p> <p>14 would need to have a certain number of ads</p> <p>15 that they're purchasing. And so an advertiser</p> <p>16 that has a smaller budget -- for whatever</p> <p>17 reason, that's a choice that the firm is</p> <p>18 making -- would not meet the minimum spend</p> <p>19 requirement and, therefore, be more likely to</p> <p>20 use a tool for small advertisers.</p> <p>21 BY MR. RYBNICEK:</p> <p>22 Q. But you agree that small advertiser</p> <p>23 buying tools have less functionality?</p> <p>24 A. Yes, I agree with that. Yes.</p> |
| <p style="text-align: right;">Page 263</p> <p>1 what you mean by unsophisticated, would not</p> <p>2 necessarily meet those thresholds and would be</p> <p>3 consumers in the buying tool market for small</p> <p>4 advertisers.</p> <p>5 Q. What I was asking you was slightly</p> <p>6 different, which is, is it fair to say that</p> <p>7 Professor Gans -- that an attribute of a small</p> <p>8 advertiser buying tool market, in which Google</p> <p>9 Ads participates, according to Professor Gans,</p> <p>10 there's less functionality in the buying</p> <p>11 tool?</p> <p>12 A. That would be fair, yes.</p> <p>13 Q. So these advertisers are less</p> <p>14 interested in the bells and whistles, for lack</p> <p>15 of a better phrase?</p> <p>16 A. I don't know if I would say they're</p> <p>17 less interested. They're less able to pay for</p> <p>18 those bells and whistles. For instance, they</p> <p>19 can't meet the minimum spend threshold.</p> <p>20 But I think many of those advertisers</p> <p>21 wish they had some of the additional</p> <p>22 functionality. They just don't have the</p> <p>23 budget to get there.</p> <p>24 Q. It's your opinion that the advertisers</p> | <p style="text-align: right;">Page 265</p> <p>1 Q. Okay. But despite the desire for more</p> <p>2 limited functionality, it's your opinion that</p> <p>3 they want to have information about all bid</p> <p>4 optimizations that buying tools implement?</p> <p>5 MR. CHANG: Objection. Form.</p> <p>6 A. I think in a market where the buying</p> <p>7 tools are representing the interests of</p> <p>8 buyers, there are buyers who would like to</p> <p>9 know what's happening to their bids when</p> <p>10 they're making decisions about how much money</p> <p>11 to allocate to various campaigns.</p> <p>12 BY MR. RYBNICEK:</p> <p>13 Q. Are advertisers using small advertiser</p> <p>14 buying tools more or less sophisticated than</p> <p>15 advertisers using large advertiser buying</p> <p>16 tools?</p> <p>17 MR. CHANG: Objection. Form.</p> <p>18 A. It's hard to say a blanket conclusion</p> <p>19 there.</p> <p>20 I mean, one example, I have a</p> <p>21 colleague who uses Google Ads to sell his</p> <p>22 textbook. He's a brilliant mind. He's so</p> <p>23 brilliant that he writes math -- competition</p> <p>24 math textbooks based on notes that he prepared</p>                  |

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| <p style="text-align: right;">Page 266</p> <p>1 for his daughter.</p> <p>2 And if you talk to him about auction</p> <p>3 theory, he knows a lot of information about</p> <p>4 auction theory, but he doesn't have the skill</p> <p>5 to bid -- for his books, it's -- if you want</p> <p>6 to find it, it's called "Hard Math for Middle</p> <p>7 School." You can buy it on Amazon and other</p> <p>8 sites -- to meet the minimum spend threshold.</p> <p>9 But I think he's a very sophisticated agent.</p> <p>10 BY MR. RYBNICEK:</p> <p>11 Q. So I think one of the examples of the</p> <p>12 work you've done in the past was related to</p> <p>13 the Boston school choice mechanism project.</p> <p>14 Is that a fair characterization?</p> <p>15 A. Yes, that's a fine characterization.</p> <p>16 Yeah.</p> <p>17 Q. Can you -- when did that project take</p> <p>18 place?</p> <p>19 A. I started working with Boston Public</p> <p>20 Schools dating in 2003.</p> <p>21 Q. And can you tell me more about what</p> <p>22 that project entailed?</p> <p>23 A. Sure.</p> <p>24 Boston Public Schools is a city that</p>                                                                                                                                                              | <p style="text-align: right;">Page 268</p> <p>1 mechanism, so this is when my involvement</p> <p>2 begins.</p> <p>3 In the Boston mechanism, it's an</p> <p>4 example of a system that's not strategy proof.</p> <p>5 So if I'm submitting my ranking over schools</p> <p>6 and there's a school that is really popular --</p> <p>7 so an example in Boston is the Timilty Middle</p> <p>8 School. A lot of families want to go there --</p> <p>9 is it in my interest to rank the Timilty</p> <p>10 Middle School as my first choice, or should I</p> <p>11 choose a safe second choice?</p> <p>12 And the way the algorithm that the</p> <p>13 city used at the time worked was it was not</p> <p>14 necessarily in your interest to behave</p> <p>15 honestly, so it was not a strategy-proof</p> <p>16 system.</p> <p>17 So this was pointed out by some other</p> <p>18 researchers, and my coauthors actually, Tayfun</p> <p>19 Sonmez and Atilla --</p> <p>20</p> <p>21 (Stenographer clarification.)</p> <p>22</p> <p>23 THE WITNESS: Oh, yeah, sorry.</p> <p>24 These are hard names. Tayfun, T-a-y-f-u-n,</p>                                                                                                                             |
| <p style="text-align: right;">Page 267</p> <p>1 had for years forced bussing, so the courts</p> <p>2 ruled that the school district was de facto</p> <p>3 segregated. In fact, it's the 50th</p> <p>4 anniversary of that decision this year, 1974.</p> <p>5 So they set up a system where they</p> <p>6 took children from different neighborhoods,</p> <p>7 and they mandated that they attended schools</p> <p>8 across town. Roughly speaking, minority</p> <p>9 children from Roxbury were bussed into</p> <p>10 Southie, which was mostly Irish and Italian</p> <p>11 neighborhoods, and vice versa. Those families</p> <p>12 were bused into Roxbury.</p> <p>13 That system evolved into the 1980s and</p> <p>14 '90s to take forced bussing and make it</p> <p>15 voluntary. So they had set up the</p> <p>16 infrastructure to bus children throughout the</p> <p>17 city, and in doing so, they said, Instead of</p> <p>18 eliminating this system, why don't we offer</p> <p>19 families the choice of whether they'd like to</p> <p>20 go to school in different neighborhoods? So</p> <p>21 that happened starting in 1989, after the</p> <p>22 court decree was vacated.</p> <p>23 And they came up with an allocation</p> <p>24 system that the literature calls the Boston</p> | <p style="text-align: right;">Page 269</p> <p>1 Sonmez, S-o-n-m-e-z. And Atilla, last name</p> <p>2 starts with an A.</p> <p>3 A. And they wrote an article pointing out</p> <p>4 that this allocation system, which affects</p> <p>5 tens of thousands of kids in the city of</p> <p>6 Boston, does not encourage honest behavior.</p> <p>7 So in 2003, the mayor and the</p> <p>8 superintendent convened a commission,</p> <p>9 primarily the superintendent, which brought</p> <p>10 together economic experts, those two names</p> <p>11 together, with Alvin Roth and myself, to</p> <p>12 demonstrate the consequences of not having a</p> <p>13 system with good incentives.</p> <p>14 So we issued a report. I testified in</p> <p>15 school committee meetings. And one of the</p> <p>16 kind of lessons that this -- part of this</p> <p>17 became my dissertation -- is that when you</p> <p>18 have a system that does not encourage honest</p> <p>19 play, a very significant effect of such a</p> <p>20 system is that there are families who don't</p> <p>21 understand those rules, and they get hurt by</p> <p>22 the fact that they don't understand those</p> <p>23 rules.</p> <p>24 So unsophisticated families who didn't</p> |

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| <p style="text-align: right;">Page 270</p> <p>1 get the message you should not apply to the</p> <p>2 Timilty School might have ranged the Timilty</p> <p>3 School as their first choice, and as a result</p> <p>4 of doing that, they lost out on their</p> <p>5 opportunity to attend their second choice or</p> <p>6 their third choice. So in the data in Boston,</p> <p>7 what we saw is something like 20 percent of</p> <p>8 elementary school applicants didn't get the</p> <p>9 memo. They ranked a school that was quite</p> <p>10 sought after and ended up unassigned.</p> <p>11 So my work involved, starting in 2003,</p> <p>12 advising the district on a strategy-proof</p> <p>13 alternative that the city eventually adopted</p> <p>14 in 2005.</p> <p>15 Q. And so you would say that the Boston</p> <p>16 school choice mechanism was not efficient; is</p> <p>17 that fair?</p> <p>18 A. So in that specific context, we have</p> <p>19 to be very careful about the definition of</p> <p>20 "efficiency."</p> <p>21 So if I use the conventional</p> <p>22 definition from economics of Pareto</p> <p>23 efficiency, the old system, I would say, was</p> <p>24 not Pareto efficient. That is, you could find</p>            | <p style="text-align: right;">Page 272</p> <p>1 Q. Okay. I think the conclusion there at</p> <p>2 the end was that it was not efficient -- or,</p> <p>3 sorry -- there were inefficiencies associated</p> <p>4 with the Boston school choice mechanism prior</p> <p>5 to your involvement?</p> <p>6 A. Yeah, that's correct. Yes, yes, yeah.</p> <p>7 I just wanted to be very precise about the</p> <p>8 definition of "efficiency," yes.</p> <p>9 Q. Which is why you got involved, right?</p> <p>10 A. Well, I was mostly concerned about the</p> <p>11 incentive issue with the Boston mechanism that</p> <p>12 I think is one of the dominant considerations</p> <p>13 in school assignment problems, that when you</p> <p>14 have a system, like Boston's old system, and</p> <p>15 you are a participant in the system, if it's</p> <p>16 not a strategy-proof system, how do I rank</p> <p>17 schools?</p> <p>18 So that was a giGanstic issue in the</p> <p>19 city of Boston because there were some family</p> <p>20 members who formed parent groups to talk about</p> <p>21 strategic heuristics. One group was called</p> <p>22 the West Zone Parents Group. They're a Google</p> <p>23 group that had all of their, you know,</p> <p>24 heuristics posted online, and that group was</p>                   |
| <p style="text-align: right;">Page 271</p> <p>1 situations where there are two applicants who</p> <p>2 had gotten assigned their second choices, so I</p> <p>3 got my second choice, and maybe you got your</p> <p>4 second choice, and I would rather have your</p> <p>5 school as my first choice, and you would</p> <p>6 rather have my school as my -- my first</p> <p>7 choice. Those inefficiencies were the result</p> <p>8 of the fact that the system is not strategy</p> <p>9 proof.</p> <p>10 If you had judged whether we could</p> <p>11 find these mutually beneficial matches from</p> <p>12 the perspective of the rankings that the</p> <p>13 participants sent into the system, you would</p> <p>14 say there are no examples of mutually</p> <p>15 beneficial trades.</p> <p>16 So long story short, whether we judged</p> <p>17 the system as efficient or not requires us to</p> <p>18 take a view on how is someone going to</p> <p>19 participate in a system that's not strategy</p> <p>20 proof?</p> <p>21 And so if we have some unsophisticated</p> <p>22 players -- this is the topic of my 2008</p> <p>23 paper -- in the Boston mechanism, you're going</p> <p>24 to end up with outcomes that are inefficient.</p> | <p style="text-align: right;">Page 273</p> <p>1 incredibly sophisticated in how they responded</p> <p>2 to the system. But the -- my impression is</p> <p>3 the vast majority of parents were not members</p> <p>4 of this West Zone Parents Group.</p> <p>5 They were concerned that there's this</p> <p>6 inequity because there's the folks who really</p> <p>7 understand the rules, and there is folks who</p> <p>8 don't. And the folks who understand the rules</p> <p>9 are able to get, you know, what we would say</p> <p>10 are strategic errants from the knowledge of</p> <p>11 the rules. So that was a concern alongside</p> <p>12 the efficiency concern.</p> <p>13 Q. But it wasn't inefficient because of</p> <p>14 lack of transparency, right?</p> <p>15 A. Well, you had a system that was not</p> <p>16 strategy proof. So when you have a system</p> <p>17 that's not strategy proof, what you need to do</p> <p>18 is come up with a way to advise participants</p> <p>19 how they should interact in the system.</p> <p>20 What the city did not do at that time</p> <p>21 is provide any information about supply/demand</p> <p>22 patterns at schools. Had they advertised to</p> <p>23 members of the community that the Timilty</p> <p>24 Middle School, the school I mentioned a second</p> |

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| <p style="text-align: right;">Page 274</p> <p>1 ago, which is very popular, is incredibly</p> <p>2 oversubscribed -- so there's 100 slots and a</p> <p>3 thousand applicants -- then family members</p> <p>4 would be able to weigh the calculation. Maybe</p> <p>5 I shouldn't waste my first choice on the</p> <p>6 Timilty Middle School and choose another</p> <p>7 school as my first choice.</p> <p>8 That's one dimension of the system</p> <p>9 that was not very transparent, you know, how</p> <p>10 do you participate.</p> <p>11 Another example in that specific</p> <p>12 system is the guidance that Boston Public</p> <p>13 Schools' officials used to give participants</p> <p>14 in the system. I remember this quote vividly</p> <p>15 to this day because I found it so shocking.</p> <p>16 In the school brochure, the advice</p> <p>17 given to participants was "For a better chance</p> <p>18 of your 'first choice' school, consider</p> <p>19 ranking less popular schools." So they are</p> <p>20 actively encouraging participants to behave in</p> <p>21 a strategic way to get one of their choices,</p> <p>22 and that created a tremendous amount of</p> <p>23 mistrust in the overall system.</p> <p>24 Q. People understood how the allocation</p> | <p style="text-align: right;">Page 276</p> <p>1 algorithm that's used to rank choices, that's</p> <p>2 what changed in 2005. That -- if by the</p> <p>3 "ranking system," you mean the set of options</p> <p>4 that people are allowed to rank, that's</p> <p>5 changed several times since that time period,</p> <p>6 and I've been involved in those reforms as</p> <p>7 well.</p> <p>8 Q. And in what way did it change? In</p> <p>9 what way did the set of options they were</p> <p>10 allowed to rank change?</p> <p>11 A. So in the early days of the system,</p> <p>12 back to 2003, the city was partitioned into</p> <p>13 three different zones, an east zone, a west</p> <p>14 zone, and a north zone. And applicants for</p> <p>15 elementary school were only allowed to apply</p> <p>16 to schools within their zone.</p> <p>17 Around 2006, they changed the system</p> <p>18 such that if I happened to live on the</p> <p>19 boundary of a zone -- let's say I lived right</p> <p>20 in between the east and west zone, but I</p> <p>21 happened to be in the east zone. They would</p> <p>22 allow you to apply to schools that were within</p> <p>23 a catchment area of your school that's in the</p> <p>24 other zone. So if I'm in the east zone and</p>     |
| <p style="text-align: right;">Page 275</p> <p>1 system worked, right? That was transparent?</p> <p>2 A. The rules were transparent, yes.</p> <p>3 Q. But yet it still led to an inefficient</p> <p>4 result; is that fair?</p> <p>5 A. That's fair, yes.</p> <p>6 Q. And that wasn't due to any lack of</p> <p>7 competition, right?</p> <p>8 A. That's correct, yes.</p> <p>9 Q. And so you helped fix the problem; is</p> <p>10 that right?</p> <p>11 A. Well, one reason I'm working on these</p> <p>12 topics 20 years later is it's a pretty large</p> <p>13 problem, so I'm not sure what you mean by</p> <p>14 "fixed the problem."</p> <p>15 What I did do, what I did work on is</p> <p>16 moving the system from Boston to a system that</p> <p>17 is a strategy-proof system. So now you can</p> <p>18 give advice to participants on how to behave</p> <p>19 in the clearinghouse. You should rank your</p> <p>20 schools honestly. And so for many years,</p> <p>21 Boston gave that kind of information to</p> <p>22 participants.</p> <p>23 Q. And did the ranking system change?</p> <p>24 A. If by "ranking system," you mean the</p>                                                                                                                               | <p style="text-align: right;">Page 277</p> <p>1 I'm on the boundary of the east and west, I</p> <p>2 could apply to the schools on the west zone.</p> <p>3 They changed the system yet again in a</p> <p>4 very high profile way in 2012 to a system that</p> <p>5 was designed by my graduate student at the</p> <p>6 time -- his name was Pang Xi (phonetic) -- to</p> <p>7 determine the set of options that you get to</p> <p>8 apply to based on where you lived. So they</p> <p>9 eliminated the concept of a zone, and they</p> <p>10 changed the -- you can call it the choice</p> <p>11 menu, the set of schools that you get to apply</p> <p>12 to, to be based on a concept that's known in</p> <p>13 the city of Boston today as the home-based</p> <p>14 model.</p> <p>15 So what they do in the system -- and</p> <p>16 this is a brain child of my Ph.D. student --</p> <p>17 is they look at your address so -- in fact,</p> <p>18 you can go online and do this pretty soon in</p> <p>19 Boston.</p> <p>20 You are then given a customized menu</p> <p>21 of choices in the city of schools that meet</p> <p>22 certain criteria. So criteria include</p> <p>23 proximity. They also include a concern for</p> <p>24 equity. So every applicant in the city of</p> |



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| <p style="text-align: right;">Page 278</p> <p>1 Boston is allowed to apply to two schools that</p> <p>2 the City has rated as Tier 1 as well as the</p> <p>3 two closest schools that the City has rated</p> <p>4 Tier 2. And they have other considerations</p> <p>5 that determine the choice set.</p> <p>6 The underlying algorithm, by the way,</p> <p>7 that reform that took place in 2005 did not</p> <p>8 change. This is just an input into the</p> <p>9 algorithm. So I think that was the most</p> <p>10 significant change in 2013, the elimination of</p> <p>11 zones in these customized choice menus.</p> <p>12 Q. Did the customized choice menus, did</p> <p>13 the number of schools you could apply to or</p> <p>14 bid for, I suppose --</p> <p>15 A. Yes.</p> <p>16 Q. -- change?</p> <p>17 A. For elementary school in the old</p> <p>18 system, depending on whether you were in the</p> <p>19 east zone or the west zone or the north zone,</p> <p>20 your typical applicant could apply to about 25</p> <p>21 to 28 schools. In the new system, the City</p> <p>22 changed the typical applicant's choice set</p> <p>23 size to be on the order of, let's say, 12</p> <p>24 to 15 schools. So for most applicants, the</p> | <p style="text-align: right;">Page 280</p> <p>1 the City would have to spend less on</p> <p>2 transportation costs. And one way the City</p> <p>3 achieved that was by limiting the number of</p> <p>4 choices that you could apply to.</p> <p>5 So in a setting like this, you know,</p> <p>6 we have competing objectives that we're</p> <p>7 thinking about. We want to let families</p> <p>8 exercise choice and do what's good for them.</p> <p>9 At the same time, the system operator, because</p> <p>10 this is a public sector resource, is balancing</p> <p>11 the costs of offering families choice. And</p> <p>12 here in Boston, it really stands out just how</p> <p>13 much the City pays on transportation. So that</p> <p>14 was kind of the mandate that was given by the</p> <p>15 mayor at the time, Tom Menino, to reform the</p> <p>16 choice system.</p> <p>17 So I think of these as distributional</p> <p>18 changes within an allocation algorithm. So</p> <p>19 with a public sector resource like schools, we</p> <p>20 care a lot about equitable distribution of</p> <p>21 resources. And, you know, the history of</p> <p>22 bussing in Boston casts a very long -- long</p> <p>23 and tall shadow. So, you know, my role as the</p> <p>24 market designer is to not quibble with that</p> |
| <p style="text-align: right;">Page 279</p> <p>1 number of choices you could apply to</p> <p>2 decreased.</p> <p>3 Q. Decreased by roughly half?</p> <p>4 A. Maybe a little bit less than half,</p> <p>5 but...</p> <p>6 Q. Yes. That seems like a bad outcome</p> <p>7 for parents and families, right?</p> <p>8 A. We have to judge this relative to the</p> <p>9 goals of the system. So one of main goals of</p> <p>10 the system at the time was to have the City</p> <p>11 pay less for transportation costs.</p> <p>12 So among large U.S. cities, Boston</p> <p>13 spends more on per-pupil transportation than</p> <p>14 any other city. So if I look at the top 100</p> <p>15 school districts in the United States, Boston</p> <p>16 spends \$2,000-plus per pupil, which is the</p> <p>17 most of any city. And if you look at the</p> <p>18 discussion in "The Boston Globe," any Boston</p> <p>19 resident is aware of challenges with buses</p> <p>20 arriving on time, dropping kids back home on</p> <p>21 time.</p> <p>22 And so the edict that was given by the</p> <p>23 mayor that led to that reform in 2012 was to</p> <p>24 have children attend school closer to home so</p>                                                | <p style="text-align: right;">Page 281</p> <p>1 objective. It's still true that within the</p> <p>2 system, given the choice sets that parents</p> <p>3 have, it's very hard to find an instance where</p> <p>4 we can make two families better off without</p> <p>5 hurting any other family. Like we said a</p> <p>6 second ago, it's not the case that you got</p> <p>7 your second choice and I got my second choice</p> <p>8 and I want your school as my first choice and</p> <p>9 vice versa.</p> <p>10 But if I were to think about a</p> <p>11 counterfactual world where you could apply to</p> <p>12 any school in the entire city, then by</p> <p>13 restricting the set of choice options, you</p> <p>14 have prevented children from maybe accessing</p> <p>15 their dream school. But the City came to the</p> <p>16 decision that they wanted to do that to be</p> <p>17 able to save on the transportation costs.</p> <p>18 Q. But families had -- were allowed to --</p> <p>19 families had fewer choices, and all things</p> <p>20 equal, we talked about how less choice is an</p> <p>21 adverse market design feature; is that fair?</p> <p>22 A. As a general principle, we want to</p> <p>23 ensure that market participants have many</p> <p>24 choices. In this specific instance and other</p>  |



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1 market design instances, we have to weigh the  
2 ability to express choices with other factors  
3 that determine the performance of the market.  
4 Q. So your point is that you need to look  
5 at these things holistically, and a reduction  
6 in choice might be justified by other  
7 considerations; is that fair?  
8 A. In the specific case of Boston,  
9 reducing choice was, you know, the -- kind of  
10 the assignment given to the design team, so it  
11 was rationalized because of this desire to try  
12 to reduce transportation costs in the system.  
13 So as a general matter, you know, when we  
14 think about designing market-clearing rules,  
15 there often are competing objectives, and we  
16 have to weigh those objectives. I agree with  
17 that.  
18 Q. We've talked about -- one of the  
19 market design principles we've talked about --  
20 and I think this is in the context of  
21 fairness. Some of these run together for me,  
22 so apologies --  
23 A. Okay.  
24 Q. -- is level playing field, the idea of

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1 a level playing field.  
2 A. (Witness nodding.)  
3 Q. How does -- is it fair to consider the  
4 notion of level playing field within the  
5 market design principle of fairness?  
6 A. That's one dimension of fairness,  
7 yes.  
8 MR. RYBNICEK: I'm going to  
9 mark -- I think this is Exhibit 4. It's a  
10 health forum article titled "Weighted Lottery  
11 to Equitably Allocate Scarce Supply of  
12 COVID-19 Monoclonal Antibody."  
13  
14 (Exhibit No. 4 marked for  
15 identification.)  
16  
17 BY MR. RYBNICEK:  
18 Q. Do you -- do you recognize this  
19 document?  
20 A. I do, yes.  
21 Q. And you see that your name is amongst  
22 the author field; is that right?  
23 A. Yes, I see my name there.  
24 Q. Do you need a minute to familiarize

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1 yourself, or are you okay?  
2 A. This is a relatively recent article.  
3 Let me just review this specific one.  
4 Okay. Yes, great. This is bringing  
5 back memories. Thank you.  
6 Q. This article describes -- or this  
7 paper describes a weighted lottery process for  
8 allocating COVID prophylaxis to high-risk  
9 individuals, right?  
10 A. That's correct, yes.  
11 Q. And do you recall how that weighted  
12 system worked?  
13 A. At a high level, I do, yes.  
14 Q. Can you explain it to me?  
15 A. Sure. So this paper is describing a  
16 partnership that three market designers,  
17 myself, Tayfun Sonmez, and another market  
18 designer, Utku Ünver, had with a team from the  
19 University of Pittsburgh's medical center.  
20 And the lead author -- the last author of this  
21 article is a doctor named Douglas White, who  
22 is a bioethicist and one of the leading  
23 experts in the United States on the fair  
24 allocation of scarce medical resources.

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1 And the article is referring to an  
2 early period of the COVID-19 pandemic when we  
3 did not have sufficient supply of one of the,  
4 at the time, most promising treatments for  
5 COVID. They call it mAB or monoclonal  
6 antibodies. And Doug White's team was tasked  
7 with figuring out how to distribute the  
8 allocation of the units mAb. I mean, the  
9 specific medical names are here for the  
10 University of Pittsburgh Medical Center, the  
11 35-hospital system in Western Pennsylvania.  
12 And what they were interested in is  
13 having a system that prioritized a subset of  
14 patients who came from disadvantaged areas,  
15 and those disadvantaged areas were defined by  
16 what's called an area deprivation index, and  
17 so it turned out that this specific setting  
18 was closely related to work that Sonmez and I  
19 had done studying how to design an allocation  
20 system for students who are applying to  
21 selective high schools in the city of Chicago  
22 once the city stopped using race as a factor  
23 in admissions and used place instead to  
24 determine your property rights to attend

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| <p style="text-align: right;">Page 286</p> <p>1 certain schools.</p> <p>2 So what we did in this system is set</p> <p>3 up a -- what Professor White used to like to</p> <p>4 call weighted lottery or what we would call in</p> <p>5 economics a reserve system, where a portion of</p> <p>6 units are allocated via lottery where the</p> <p>7 lottery is weighted in a way to achieve</p> <p>8 distributional goals.</p> <p>9 So the specific details on the</p> <p>10 weighting are described in this paper, and</p> <p>11 what this paper is specifically about is how</p> <p>12 well did that system work in achieving the</p> <p>13 goals? So it builds on earlier work that we</p> <p>14 had done with White to look at different ways</p> <p>15 to accommodate equity considerations and the</p> <p>16 allocation of scarce medical resources during</p> <p>17 pandemics.</p> <p>18 Q. Thanks for that overview.</p> <p>19 So is it fair to say that individuals</p> <p>20 from the disadvantaged communities were</p> <p>21 weighted in the lottery by being entered in</p> <p>22 additional times?</p> <p>23 A. Now, let me try to remember. If you'd</p> <p>24 just give me one second.</p>                      | <p style="text-align: right;">Page 288</p> <p>1 Q. Got it.</p> <p>2 And so did the program achieve its</p> <p>3 goals?</p> <p>4 A. So there's many aspects of that</p> <p>5 question of achieving its goals. So --</p> <p>6 Q. I guess I can simplify it.</p> <p>7 A. Okay.</p> <p>8 Q. What's it say by "main outcomes"?</p> <p>9 A. Okay. The main outcomes here, and let</p> <p>10 me read this. "Proportion of individuals from</p> <p>11 disadvantaged neighborhoods and black</p> <p>12 individuals who are allocated and received</p> <p>13 tixagevimab" --</p> <p>14</p> <p>15 (Stenographer clarification.)</p> <p>16</p> <p>17 A. Okay. Let's just say were allocated</p> <p>18 and received the monoclonal antibody. That</p> <p>19 was the main outcome.</p> <p>20 BY MR. RYBNICEK:</p> <p>21 Q. And so did individuals with -- who</p> <p>22 were weighted more heavily ultimately receive</p> <p>23 the therapy at a higher rate?</p> <p>24 A. Let's look at results here. So I'm</p>                                                                                                                                                                                 |
| <p style="text-align: right;">Page 287</p> <p>1 Q. Sure. Take your time.</p> <p>2 A. How the weighting took place.</p> <p>3 (Witness reviews document.)</p> <p>4 I think the way you described it is</p> <p>5 equivalent to the way that this was actually</p> <p>6 undertaken.</p> <p>7 We could think of a lottery, which is</p> <p>8 everyone has an equal probability of getting</p> <p>9 assigned that one unit of the monoclonal</p> <p>10 antibody, or what we could do instead is</p> <p>11 weight the lottery such that if you're from a</p> <p>12 region that has an ADI that is sufficiently</p> <p>13 high -- I think it was 8, 9, and 10 -- then</p> <p>14 the probability that you have of getting a</p> <p>15 unit is going to be higher than folks who are</p> <p>16 not from that area.</p> <p>17 So that's what we would call a reserve</p> <p>18 system. Also, we have a portion of units set</p> <p>19 aside that are reserved for a particular group</p> <p>20 of participants in the allocation system, and</p> <p>21 their prioritization, that is, their odds in</p> <p>22 this case, because it's a lottery system,</p> <p>23 differs because they're a member of this</p> <p>24 reserve group.</p> | <p style="text-align: right;">Page 289</p> <p>1 reading from the results. "A higher</p> <p>2 proportion of individuals from disadvantaged</p> <p>3 neighborhoods was allocated the drug in the</p> <p>4 ADI, the area of deprivation, index-weighted</p> <p>5 lottery compared with the unweighted lottery."</p> <p>6 So that's one of the main outcomes</p> <p>7 that's specified in the study.</p> <p>8 "The proportion of black individuals</p> <p>9 allocated the drug was greater in the weighted</p> <p>10 lottery."</p> <p>11 Q. Was there anything anticompetitive</p> <p>12 about this lottery?</p> <p>13 MR. CHANG: Objection. Form.</p> <p>14 A. I don't even know how to process that</p> <p>15 question.</p> <p>16 So if I were to think about</p> <p>17 anticompetitive conduct, this is a pandemic</p> <p>18 scenario where there is a scarcity of a given</p> <p>19 quantity. And so the demand and supply here</p> <p>20 involved the demand for the drug from</p> <p>21 patients -- here, 10,834 individuals were</p> <p>22 eligible for the drug -- and the supply. The</p> <p>23 supply was only 450 units.</p> <p>24 So this is a setting where there's no</p> |

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| <p style="text-align: right;">Page 290</p> <p>1 price, so defining what is competitive here<br/> 2 without a price is a challenging notion.<br/> 3 What I can say, however, is that the<br/> 4 outcome here -- because if we model this --<br/> 5 this is what we've done in other papers -- is<br/> 6 one where people have preferences, where they<br/> 7 prefer getting the drug versus not getting the<br/> 8 drug. Provided that we're not wasting any<br/> 9 units of these monoclonal antibody, there's no<br/> 10 way to make someone better off without making<br/> 11 someone worse off, so the outcome here would<br/> 12 be Pareto efficient.<br/> 13 BY MR. RYBNICEK:<br/> 14 Q. And do you think this lottery system<br/> 15 was fair?<br/> 16 MR. CHANG: Objection. Form.<br/> 17 A. My role in this particular problem was<br/> 18 implementing the goals of the stakeholder<br/> 19 community that Professor White convened. So<br/> 20 this is really an example of the economist as<br/> 21 engineer, so I didn't take a position on the<br/> 22 objectives of the stakeholders.<br/> 23 But given their objectives -- so the<br/> 24 way they did this in Pittsburgh was they had a</p>                                                           | <p style="text-align: right;">Page 292</p> <p>1 Pittsburgh Medical Center, so I'm certain that<br/> 2 the lottery was a fair lottery. This<br/> 3 allocation mechanism satisfies the property<br/> 4 that if I'm from a low ADI area, a not<br/> 5 disadvantaged neighborhood area, then my<br/> 6 probability of getting assigned is the same as<br/> 7 another patient from a low ADI area. So it<br/> 8 satisfies the equal treatment of equals<br/> 9 property.<br/> 10 Furthermore, the second type of<br/> 11 individual here is someone from a high ADI<br/> 12 area. And we have two patients from high ADI<br/> 13 areas, because it's a fair lottery among that<br/> 14 group, we satisfy the equal treatment of<br/> 15 equals property. They would -- they have the<br/> 16 same probability of getting assigned.<br/> 17 So using that as a definition of<br/> 18 fairness, which is what we have written about<br/> 19 in other papers, I would say this, given the<br/> 20 objective, was a fair procedure.<br/> 21 BY MR. RYBNICEK:<br/> 22 Q. And so it was fair because -- in the<br/> 23 context of the objectives of those running the<br/> 24 lottery; is that fair?</p>                                   |
| <p style="text-align: right;">Page 291</p> <p>1 community engagement process where they had<br/> 2 different members of the community, including<br/> 3 doctors, including lawyers, including<br/> 4 religious personnel, weighing in on what is an<br/> 5 adequate way to allocate monoclonal antibody<br/> 6 from the perspective of health equity.<br/> 7 I'm not an expert on health equity,<br/> 8 but given their goals of trying to prioritize<br/> 9 certain disadvantaged neighborhoods, the task<br/> 10 then became, as the engineer -- as the<br/> 11 economic engineer, what is a way to implement<br/> 12 that objective using an allocation mechanism.<br/> 13 So when I am asked the question that you've<br/> 14 asked about, is this fair or not, I would<br/> 15 judge that with respect to the objectives.<br/> 16 And so in this system, it's a lottery<br/> 17 system. So if we go back to the definition of<br/> 18 fairness as equal treatments of equals, we<br/> 19 have two different types of patients here. We<br/> 20 have patients from, you know, high ADI areas<br/> 21 and patients from non-ADI areas. It's a fair<br/> 22 lottery.<br/> 23 In fact, in this case, we even<br/> 24 provided computer code to the University of</p> | <p style="text-align: right;">Page 293</p> <p>1 MR. CHANG: Objection. Form.<br/> 2 A. It's fair because the stakeholders<br/> 3 came up with the objective, right, through<br/> 4 this community engagement process. And then<br/> 5 I've given you a mathematical definition of<br/> 6 fairness in this context. And the allocation<br/> 7 system that we designed, in collaboration with<br/> 8 Professor White and his team, satisfied that<br/> 9 property, this equal treatment of equals<br/> 10 property.<br/> 11 BY MR. RYBNICEK:<br/> 12 Q. Okay. So -- but fairness is judged<br/> 13 within the context of what the objectives of a<br/> 14 particular marketplace is; is that accurate?<br/> 15 MR. CHANG: Objection. Form.<br/> 16 A. In this specific outcome, in this<br/> 17 specific scenario, the notion of fairness that<br/> 18 I've proposed to you is this equal treatment<br/> 19 of equals idea, this, you know, Aristotelian<br/> 20 idea that is relevant in this setting because<br/> 21 there's no price, right, so there are aspects<br/> 22 of what you're saying that could be right<br/> 23 because we've only partitioned the problem<br/> 24 into two types of patients, right? There are</p> |

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| <p style="text-align: right;">Page 294</p> <p>1 patients from low-income neighborhoods and</p> <p>2 patients from high-income neighborhoods. So</p> <p>3 that is a constraint that was given to us as</p> <p>4 the designer.</p> <p>5 But once we have that constraint, the</p> <p>6 definition of fairness is, you know, this</p> <p>7 philosophical definition of what is truly</p> <p>8 fair.</p> <p>9 BY MR. RYBNICEK:</p> <p>10 Q. Yes. Okay. I guess -- I think I'm</p> <p>11 just restating what you said earlier --</p> <p>12 A. Okay.</p> <p>13 Q. -- which is fairness is judged from</p> <p>14 the perspective of the objective of a</p> <p>15 particular program.</p> <p>16 In this case, the objective of the</p> <p>17 program was to deliver a scarce supply of</p> <p>18 monoclonal antibodies at a higher rate to</p> <p>19 disadvantaged communities.</p> <p>20 A. Yeah.</p> <p>21 Q. Is that fair?</p> <p>22 MR. CHANG: Objection. Form.</p> <p>23 A. Could you restate the question? I</p> <p>24 just --</p>           | <p style="text-align: right;">Page 296</p> <p>1 we would in technical economics, there are</p> <p>2 many efficient outcomes.</p> <p>3 Then we turn to fairness. So I have</p> <p>4 fairness with respect to the way that the</p> <p>5 stakeholders have defined the problem. I</p> <p>6 wouldn't call that -- this is what I'm wanting</p> <p>7 to emphasize. I wouldn't call that the</p> <p>8 objective. I would say that's more of a</p> <p>9 constraint.</p> <p>10 So they said you can only condition</p> <p>11 delivery of the drug on this one attribute of</p> <p>12 the patients, where they live. Okay. Now,</p> <p>13 for instance, they did not say you can</p> <p>14 condition delivery of the drug on the race of</p> <p>15 the patient. Okay? There's a debate about</p> <p>16 whether that is, in fact, legal or</p> <p>17 appropriate. Okay?</p> <p>18 So given that constraint, I then</p> <p>19 appealed to my definition of fairness, which</p> <p>20 comes from Aristotle and others, and ask, with</p> <p>21 respect to that constraint, is the allocation</p> <p>22 mechanism producing a fair outcome?</p> <p>23 Q. Okay. Did the participants in this</p> <p>24 lottery know that some individuals were</p>                                    |
| <p style="text-align: right;">Page 295</p> <p>1 BY MR. RYBNICEK:</p> <p>2 Q. Sure.</p> <p>3 A. -- want to make sure I am</p> <p>4 understanding what you're --</p> <p>5 Q. What I had --</p> <p>6 A. Okay.</p> <p>7 Q. What I had heard you say earlier is</p> <p>8 that fairness is assessed in the context of</p> <p>9 the objection -- objective of a particular</p> <p>10 program --</p> <p>11 A. Yeah.</p> <p>12 Q. -- marketplace, lottery.</p> <p>13 In this context, the objective was to</p> <p>14 deliver therapies to a particular community at</p> <p>15 a higher rate than other communities, and that</p> <p>16 led you to conclude that it was fair; is that</p> <p>17 accurate?</p> <p>18 A. I mean, there's some nuance to what</p> <p>19 you've just said. I just want to be very</p> <p>20 clear here.</p> <p>21 So in this problem, we have many</p> <p>22 outcomes that are efficient because the</p> <p>23 preferences are I want the drug versus I don't</p> <p>24 want the drug, right? So using efficiency as</p> | <p style="text-align: right;">Page 297</p> <p>1 weighted more heavily than others?</p> <p>2 A. In my understanding -- well, this</p> <p>3 specific one in the paper that you sent me,</p> <p>4 let me just see what we said about that.</p> <p>5 (Witness reviews document.)</p> <p>6 I don't remember in this specific</p> <p>7 instance what the participants were informed</p> <p>8 about the specific mechanism. The mechanism</p> <p>9 rules were and prioritization was the result</p> <p>10 of community engagement, and they were in line</p> <p>11 with the rules that were discussed by the</p> <p>12 Commonwealth of Pennsylvania, which had put</p> <p>13 out public documents on its ethical allocation</p> <p>14 goals. So that's what we talk about here in</p> <p>15 this paper.</p> <p>16 But, you know, this was in the kind of</p> <p>17 peak of the COVID pandemic, where there was</p> <p>18 extreme scarcity, so I don't remember, you</p> <p>19 know, what was -- beyond what's written in</p> <p>20 this paper about precisely what was relayed to</p> <p>21 individuals.</p> <p>22 I do remember one aspect, though, that</p> <p>23 comes to mind right now, which is we had this</p> <p>24 visual basic macro in Microsoft Excel that ran</p> |

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| <p style="text-align: right;">Page 298</p> <p>1 this lottery for the UPMC team that one of my</p> <p>2 coauthors designed for them. And what they</p> <p>3 would do is they would calibrate the cutoff</p> <p>4 number that you needed to be, so if the</p> <p>5 patients were given random numbers, and that</p> <p>6 information was given to the clinicians.</p> <p>7 So if someone wanted to ask the</p> <p>8 clinician, Why is it that I did not get the</p> <p>9 monoclonal antibody? the clinician was</p> <p>10 equipped to say, The reason you did not get</p> <p>11 this drug is because your lottery number was</p> <p>12 not above the lottery number that you would</p> <p>13 need to get the drug. So that was a specific</p> <p>14 request that the team had at UPMC.</p> <p>15 Q. But would you agree that it would --</p> <p>16 it would be deceptive not to tell lottery</p> <p>17 participants that some were weighted more</p> <p>18 heavily than others?</p> <p>19 A. As a matter of economics, the word</p> <p>20 "deceptive," I think it's the task of the</p> <p>21 market designer to tell participants what the</p> <p>22 allocation scheme is. So --</p> <p>23 Q. So sometimes it's fine not to tell</p> <p>24 market participants?</p> | <p style="text-align: right;">Page 300</p> <p>1 It's captioned "Q and A, How an Economist</p> <p>2 Unlocked Hidden Truths About School Choice."</p> <p>3</p> <p>4 (Exhibit No. 5 marked for</p> <p>5 identification.)</p> <p>6</p> <p>7 BY MR. RYBNICEK:</p> <p>8 Q. I assume this is familiar to you; is</p> <p>9 that correct?</p> <p>10 A. It's definitely been a while since</p> <p>11 I've seen this, and I look much younger in</p> <p>12 this picture.</p> <p>13 Q. That's the way time works.</p> <p>14 If you need a minute, feel free to</p> <p>15 familiarize yourself --</p> <p>16 A. Let me take that minute, yes.</p> <p>17 (Witness reviews document.)</p> <p>18 Okay. Great. I have had a chance to</p> <p>19 read this.</p> <p>20 Q. Is having more choice ever a bad</p> <p>21 thing?</p> <p>22 MR. CHANG: Objection to form.</p> <p>23 A. It depends on the context.</p> <p>24 BY MR. RYBNICEK:</p>                                                                                                                                                                       |
| <p style="text-align: right;">Page 299</p> <p>1 A. No, no, no.</p> <p>2 MR. CHANG: Objection. Form.</p> <p>3 A. I'm sorry. So maybe I</p> <p>4 miscommunicated.</p> <p>5 It's not fine to tell participants,</p> <p>6 especially in this kind of situation, where at</p> <p>7 the time -- you know, it's turned out that</p> <p>8 monoclonal antibodies are not as effective as</p> <p>9 we thought, by the way. So this is back in</p> <p>10 2002 -- 2022. Many people thought that</p> <p>11 monoclonal antibody -- antibody infusions</p> <p>12 were -- you know, in other influenza pandemics</p> <p>13 have been quite effective, so there was a lot</p> <p>14 of hope with this particular treatment.</p> <p>15 And if they are rationing it in a</p> <p>16 life-or-death situation and the participants</p> <p>17 who are being rationed are not informed about</p> <p>18 the rules, I think that is not a good</p> <p>19 allocation system.</p> <p>20 Q. Okay. You can put that to the side.</p> <p>21 A. Okay.</p> <p>22 Q. Tab 13.</p> <p>23 MR. RYBNICEK: We'll mark this</p> <p>24 "Wall Street Journal" article as Exhibit 5.</p>                                                                                                                     | <p style="text-align: right;">Page 301</p> <p>1 Q. But it may?</p> <p>2 A. It could be, yes.</p> <p>3 Q. On the -- you're already there, I</p> <p>4 think. On what's marked page 4, essentially</p> <p>5 the second to the last page, at the bottom,</p> <p>6 there's a question posed to you, "Do you think</p> <p>7 giving people more choices in their education</p> <p>8 or their children's education is always a good</p> <p>9 thing?"</p> <p>10 And your response is "One of the</p> <p>11 narratives of school choice reform, going all</p> <p>12 the way back to Milton Friedman, is giving</p> <p>13 people choice is inherently good. Now we are</p> <p>14 starting to see a couple of pretty</p> <p>15 high-profile scenarios, like the Louisiana</p> <p>16 voucher system, where --</p> <p>17</p> <p>18 (Stenographer clarification.)</p> <p>19</p> <p>20 BY MR. RYBNICEK:</p> <p>21 Q. -- a couple of pretty high-profile</p> <p>22 scenarios, like the Louisiana voucher system,</p> <p>23 where giving people choice actually results in</p> <p>24 people learning less.</p> |



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1 So it's -- I have just a simple  
2 question, which is it depends on the context  
3 whether more choice or less is beneficial,  
4 correct?  
5 A. Yeah, I would agree with that  
6 statement. In this context, we're looking at  
7 families expressing a choice to go to a  
8 private school, and what we saw was parents  
9 who chose to send their kid to a private  
10 school ended up having the children do worse  
11 on standardized tests, but, of course, those  
12 family members may have been opting to go to  
13 those private schools for reasons other than  
14 standardized tests.  
15 So an interesting feature of  
16 Louisiana's private school voucher system is  
17 that public funds were used to allow children  
18 to attend religious schools. So whether  
19 choice is good or bad in this specific context  
20 depends on what the objectives are of the  
21 participants in the system. And so what we  
22 usually do in economics is we start with a  
23 revealed preference idea that people with full  
24 information will make choices that are in

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1 their interest.  
2 So even reading this quote today, I  
3 think is sufficiently nuanced. I say here,  
4 "We are starting to see a couple of high  
5 scenarios where people actually learn less."  
6 I'm not saying it's bad for them. If I get to  
7 send my kid to a religious school and I care a  
8 lot about sending my kid to Catholic school,  
9 you may tell me the performance of my kid on a  
10 standardized test one year after attending the  
11 school is not necessarily a bad thing, and, in  
12 fact, that was the reaction we got from this  
13 study. The State of Louisiana continued to  
14 run this program for several years.  
15 Q. Okay. You can put that to the side.  
16 A. Okay.  
17 Q. How did you prepare for this  
18 deposition?  
19 A. To prepare for this deposition, I  
20 reread my report and reviewed material that I  
21 cited in my report.  
22 Q. And did you meet with any individuals  
23 to prepare?  
24 A. Yes.

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1 Q. And who did you meet with?  
2 A. I met with counsel, and I met with the  
3 team that assisted me in preparing this  
4 report.  
5 Q. Anybody else?  
6 A. No.  
7 Q. And how many meetings approximately  
8 did you have?  
9 A. My best guess is between five and ten.  
10 Q. And how long were each of those  
11 meetings on average?  
12 A. Between 45 minutes to an hour and a  
13 half roughly.  
14 Q. And you mentioned you met with your  
15 team. Who is your team?  
16 A. I was assisted by Keystone Consulting  
17 in preparing this report.  
18 Q. And how many individuals at Keystone  
19 assisted you approximately?  
20 A. A handful of individuals. You know, I  
21 don't know the exact number.  
22 Q. More than five?  
23 A. I think less than five.  
24 Q. When did you first learn about this

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1 case?  
2 A. Let me tell you exactly when I was  
3 retained by looking at my report here. I  
4 think we have listed the dates precisely. I  
5 mean, I can't find it right now. It's roughly  
6 the end of 2021.  
7 I'm sorry. Here, I found it. I was  
8 retained in July of 2021.  
9 Q. And that's when you learned about the  
10 case as well?  
11 A. I think I may have read about aspects  
12 of this case in the news prior to that date.  
13 Q. Did you talk to anybody about the case  
14 before being retained?  
15 A. No.  
16 Q. And when did you start working on your  
17 report?  
18 A. Shortly after the date I was retained,  
19 a couple of months after July 2021.  
20 Q. So is it fair to say you've been  
21 working on your report for over three years?  
22 Strike that.  
23 Is it fair to say you worked on your  
24 report for over three years?



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| <p style="text-align: right;">Page 306</p> <p>1 A. Yeah, that's fair to say.</p> <p>2 Q. And how many hours would you</p> <p>3 approximate that you worked on your report?</p> <p>4 A. I don't know exactly but approximately</p> <p>5 somewhere around the order of maybe 400 hours,</p> <p>6 3- to 400 hours.</p> <p>7 Q. Three to -- okay.</p> <p>8 And was there any additional time that</p> <p>9 you worked on this case that you're not</p> <p>10 counting in the time that you worked on your</p> <p>11 report?</p> <p>12 A. I think that's the total sum of time</p> <p>13 I've spent studying the issues here.</p> <p>14 Q. Did you draft your report?</p> <p>15 A. Yes.</p> <p>16 Q. How did -- well, what's -- and what is</p> <p>17 your compensation in this case?</p> <p>18 A. I am compensated at the rate of \$1,200</p> <p>19 an hour.</p> <p>20 Q. And did you receive any compensation</p> <p>21 from the work that flowed to your team at</p> <p>22 Keystone?</p> <p>23 A. I did not.</p> <p>24 Q. And do you know what your team was</p>                              | <p style="text-align: right;">Page 308</p> <p>1 right?</p> <p>2 A. Appendix B lists the materials that I</p> <p>3 relied upon and the materials I considered.</p> <p>4 Q. Well you're getting ahead of me,</p> <p>5 Professor.</p> <p>6 A. That's just the title.</p> <p>7 Q. What is the difference between the</p> <p>8 materials you relied upon and the materials</p> <p>9 you considered?</p> <p>10 A. The materials that I relied upon are</p> <p>11 listed as materials that I relied upon in</p> <p>12 forming my expert opinion. So these are</p> <p>13 things that are cited in my report, academic</p> <p>14 works, public information, documents, and</p> <p>15 depositions.</p> <p>16 Q. And the materials you considered are</p> <p>17 ones that you reviewed but are not cited? Is</p> <p>18 that an accurate description?</p> <p>19 A. That is an accurate description. So</p> <p>20 these are materials that I had access to, and</p> <p>21 I looked at many of these in forming my</p> <p>22 opinion.</p> <p>23 Q. So just looking at the -- the</p> <p>24 appendices aren't numbered. But on the next</p>                                                                                                           |
| <p style="text-align: right;">Page 307</p> <p>1 compensated?</p> <p>2 A. I do not know.</p> <p>3 Q. You don't know their margin?</p> <p>4 A. I don't.</p> <p>5 Q. Are you currently working -- we may</p> <p>6 have covered this, but I'll ask just in case.</p> <p>7 Are you currently working as an expert in any</p> <p>8 other case?</p> <p>9 MR. CHANG: Objection. I'm</p> <p>10 going to instruct the witness not to answer</p> <p>11 except for the cases where he has been</p> <p>12 disclosed as a testifying expert.</p> <p>13 A. The list of cases where I have been</p> <p>14 disclosed as a testifying expert are in my</p> <p>15 report that we talked about, the Iowa case.</p> <p>16 BY MR. RYBNICEK:</p> <p>17 Q. Great. Did the attorneys assisting</p> <p>18 you draft any portions of your report?</p> <p>19 MR. CHANG: Objection. I'm</p> <p>20 going to instruct the witness not to answer</p> <p>21 per the expert stipulation.</p> <p>22 BY MR. RYBNICEK:</p> <p>23 Q. Appendix B of your opening report</p> <p>24 lists the materials you relied upon; is that</p> | <p style="text-align: right;">Page 309</p> <p>1 page, after the heading "Materials</p> <p>2 Considered," it says you considered all</p> <p>3 available discovery responses produced within</p> <p>4 the matter of State of Texas, et al. v.</p> <p>5 Google, including the parties' initial</p> <p>6 disclosures, discovery responses, and</p> <p>7 objections to interrogatories, written</p> <p>8 responses to plaintiffs' Rule 30(b)(6) notice.</p> <p>9 You reviewed all of those?</p> <p>10 A. I ran queries through these documents,</p> <p>11 the entire list here.</p> <p>12 Q. And you ran queries through these</p> <p>13 documents. Do you -- does that mean that you</p> <p>14 didn't actually read word for word each of</p> <p>15 these documents, but you searched them?</p> <p>16 A. Right. I focused my attention on</p> <p>17 parts of these documents that were most</p> <p>18 relevant do my assignment.</p> <p>19 Q. So it's not the case that you reviewed</p> <p>20 word for word each of the materials listed in</p> <p>21 the materials considered; is that right?</p> <p>22 A. That's a fair description.</p> <p>23 THE WITNESS: Abe, can I ask --</p> <p>24 I have to go to the restroom. I can hold it</p> |

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| <p style="text-align: right;">Page 310</p> <p>1 for a couple of minutes, but if it's a natural</p> <p>2 place to break --</p> <p>3 MR. RYBNICEK: Let's go off the</p> <p>4 record. We're going to take a -- can we go</p> <p>5 off record?</p> <p>6 MR. CHANG: Yes.</p> <p>7 THE VIDEOGRAPHER: Time is 5:14.</p> <p>8 We're off the record.</p> <p>9</p> <p>10 (Recess taken from 5:15 p.m.</p> <p>11 to 5:37 p.m.)</p> <p>12</p> <p>13 THE VIDEOGRAPHER: We are back</p> <p>14 on the record. The time is 5:37.</p> <p>15 MR. RYBNICEK: Great.</p> <p>16 Dr. Pathak, I have no further</p> <p>17 questions. I appreciate your time.</p> <p>18</p> <p>19 CROSS-EXAMINATION</p> <p>20 BY MR. CHANG:</p> <p>21 Q. Dr. Pathak, a few questions for you.</p> <p>22 Do you recall the questions that</p> <p>23 Google's counsel asked you today regarding</p> <p>24 your opinions in your opening report?</p>                 | <p style="text-align: right;">Page 312</p> <p>1 Q. You're not offering any new opinions</p> <p>2 as you sit here today, correct?</p> <p>3 A. That is correct.</p> <p>4 Q. You understand that today you</p> <p>5 testified regarding liability?</p> <p>6 A. Yes.</p> <p>7 Q. Do you understand that the parties</p> <p>8 will later depose you, if needed, to discuss</p> <p>9 your remedies-related opinions in your opening</p> <p>10 and rebuttal reports?</p> <p>11 A. Yes, I understand that.</p> <p>12 Q. Do you recall Google's counsel asking</p> <p>13 you about your -- about conclusions and</p> <p>14 whether you offered them as to Google's</p> <p>15 alleged conduct?</p> <p>16 A. Yes.</p> <p>17 Q. Do you recall Google's counsel asking</p> <p>18 you about whether Google's alleged conduct had</p> <p>19 anticompetitive effects?</p> <p>20 A. Yes.</p> <p>21 Q. Do you come to independent conclusions</p> <p>22 about whether Google's conduct had</p> <p>23 independent -- had anticompetitive effects?</p> <p>24 A. Yes.</p> |
| <p style="text-align: right;">Page 311</p> <p>1 A. Yes.</p> <p>2 Q. Was any of your testimony today</p> <p>3 intended to change the opinions expressed in</p> <p>4 your opening report?</p> <p>5 A. No.</p> <p>6 Q. Was any of your testimony today</p> <p>7 intended to limit the opinions expressed in</p> <p>8 your opening report?</p> <p>9 A. No.</p> <p>10 Q. Was any of your testimony today</p> <p>11 intended to change the opinions expressed in</p> <p>12 your rebuttal report?</p> <p>13 A. No.</p> <p>14 Q. Was any of your testimony today</p> <p>15 intended to limit the opinions expressed in</p> <p>16 your rebuttal report?</p> <p>17 A. No.</p> <p>18 Q. Did you have sufficient facts and data</p> <p>19 to reach your opinions within your two reports</p> <p>20 in this case?</p> <p>21 A. Yes.</p> <p>22 Q. Did you offer any new opinions in your</p> <p>23 reports today?</p> <p>24 A. No.</p> | <p style="text-align: right;">Page 313</p> <p>1 Q. Do you recall being asked by Google's</p> <p>2 counsel about the COVID market design exercise</p> <p>3 that you carried out in Boston?</p> <p>4 A. I believe it wasn't in Boston, but I</p> <p>5 do remember the COVID market design questions.</p> <p>6 Q. Sorry. Which city was that?</p> <p>7 A. Pittsburgh.</p> <p>8 Q. Do you recall being asked by Google's</p> <p>9 counsel about a COVID market design in</p> <p>10 Pittsburgh?</p> <p>11 A. Yes, I do.</p> <p>12 Q. Were there special circumstances that</p> <p>13 were present in that particular exercise that</p> <p>14 are not present in the ad tech industry?</p> <p>15 MR. RYBNICEK: Objection to</p> <p>16 form.</p> <p>17 A. Yes, there were, like a global</p> <p>18 pandemic.</p> <p>19 MR. CHANG: Pass the witness.</p> <p>20 MR. RYBNICEK: We have no</p> <p>21 further questions.</p> <p>22 THE VIDEOGRAPHER: The time is</p> <p>23 5:41. We're off the record.</p> <p>24 THE STENOGRAPHER: I've got standing</p>         |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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| <p style="text-align: right;">Page 314</p> <p>1 orders for all parties.</p> <p>2 MR. CHANG: Yes. We need a</p> <p>3 rough as well.</p> <p>4 MR. RYBNICEK: Yes. Thank you.</p> <p>5</p> <p>6</p> <p>7 (Deposition concluded at 5:42 p.m.)</p> <p>8</p> <p>9</p> <p>10</p> <p>11</p> <p>12</p> <p>13</p> <p>14</p> <p>15</p> <p>16</p> <p>17</p> <p>18</p> <p>19</p> <p>20</p> <p>21</p> <p>22</p> <p>23</p> <p>24</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <p style="text-align: right;">Page 316</p> <p>1 IN THE UNITED STATES DISTRICT COURT</p> <p>2 FOR THE EASTERN DISTRICT OF TEXAS</p> <p>3 SHERMAN DIVISION</p> <p>4</p> <p>5 *****</p> <p>6 THE STATE OF TEXAS, et al.,</p> <p>7 Plaintiffs</p> <p>8 vs. CA NO. 4:20-cv-00957-sdj</p> <p>9 GOOGLE LLC,</p> <p>10 Defendant</p> <p>11 *****</p> <p>12</p> <p>13 I, PARAG PATHAK, PH.D., say that I have read</p> <p>14 the foregoing deposition and hereby declare under</p> <p>15 penalty of perjury the foregoing is true</p> <p>16 and correct: (as prepared) (as corrected on errata.)</p> <p>17 Executed this ____ day of _____,</p> <p>18 2024, at _____, _____.</p> <p>19</p> <p>20</p> <p>21 _____</p> <p>22 PARAG PATHAK, PH.D.</p> <p>23</p> <p>24 Job No. CS6919048</p> |
| <p style="text-align: right;">Page 315</p> <p>1 CERTIFICATION</p> <p>2 I, DARLENE M. COPPOLA, a Notary Public, do hereby</p> <p>3 certify that PARAG PATHAK, PH.D., after having</p> <p>4 satisfactorily identifying himself, came before me on</p> <p>5 the 14th day of October 2024, in Boston,</p> <p>6 Massachusetts, and was by me duly sworn to testify to</p> <p>7 the truth and nothing but the truth as to his</p> <p>8 knowledge touching and concerning the matters in</p> <p>9 controversy in this cause; that he was thereupon</p> <p>10 examined upon his oath and said examination reduced to</p> <p>11 writing by me; and that the statement is a true record</p> <p>12 of the testimony given by the witness, to the best of</p> <p>13 my knowledge and ability.</p> <p>14 I further certify that I am not a relative or</p> <p>15 employee of counsel/attorney for any of the parties,</p> <p>16 nor a relative or employee of such parties, nor am I</p> <p>17 financially interested in the outcome of the action.</p> <p>18 WITNESS MY HAND THIS 14th day of October, 2024.</p> <p>19</p> <p>20</p> <p>21 <del>By 2024.10.14, Darlene M. Coppola</del> My commission expires:</p> <p>22 DARLENE M. COPPOLA November 2, 2029</p> <p>23 NOTARY PUBLIC</p> <p>24 REGISTERED MERIT REPORTER</p> <p>CERTIFIED REALTIME REPORTER</p> | <p style="text-align: right;">Page 317</p> <p>1 CORRECTION PAGE</p> <p>2 DEPONENT: PARAG PATHAK, PH.D.</p> <p>3 DATE TAKEN: OCTOBER 14, 2024</p> <p>4 CASE: STATE OF TEXAS, ET AL. VS. GOOGLE LLC</p> <p>5 *****</p> <p>6 PAGE / LINE / SHOULD READ</p> <p>7 ____/____/____</p> <p>8 ____/____/____</p> <p>9 ____/____/____</p> <p>10 ____/____/____</p> <p>11 ____/____/____</p> <p>12 ____/____/____</p> <p>13 ____/____/____</p> <p>14 ____/____/____</p> <p>15 ____/____/____</p> <p>16 ____/____/____</p> <p>17 ____/____/____</p> <p>18 ____/____/____</p> <p>19 ____/____/____</p> <p>20 ____/____/____</p> <p>21 ____/____/____</p> <p>22 ____/____/____</p> <p>23 ____/____/____</p> <p>24 ____/____/____</p> <p>Job No. CS6919048</p>                                 |

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1 Abraham Chang, Esq.  
2 Abraham.chang@nortonrosefulbright.com  
3 October 15, 2024  
4 RE: State Of Texas Et Al v. Google LLC  
5 10/14/2024, Parag Pathak (#6919048)  
6 The above-referenced transcript is available for  
7 review.  
8 Within the applicable timeframe, the witness should  
9 read the testimony to verify its accuracy. If there are  
10 any changes, the witness should note those with the  
11 reason, on the attached Errata Sheet.  
12 The witness should sign the Acknowledgment of  
13 Deponent and Errata and return to the deposing attorney.  
14 Copies should be sent to all counsel, and to Veritext at  
15 erratas-cs@veritext.com  
16 Return completed errata within 30 days from  
17 receipt of testimony.  
18 If the witness fails to do so within the time  
19 allotted, the transcript may be used as if signed.  
20  
21  
22 Yours,  
23 Veritext Legal Solutions  
24  
25

81 (Page 318)

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